DOCUMENT RESUME

ED 441 896 UD 033 563

AUTHOR	Ham, Sandra; Walker, Erica
TITLE	Getting to the Right Algebra: The Equity 2000 Initiative in Milwaukee Public Schools. MDRC Working Papers.
INSTITUTION	Manpower Demonstration Research Corp., New York, NY.
SPONS AGENCY	Center for Research on the Education of Students Placed At Risk, Baltimore, MD.; College Board, New York, NY.; Ford Foundation, New York, NY.; Alcoa Foundation, Pittsburgh, PA.; James G. Irvine Foundation, San Francisco, CA.
PUB DATE	1999-04-00
NOTE	78p.; Funding also provided by the Ambrose Monell Foundation.
AVAILABLE FROM	Manpower Demonstration Research Corporation, 16 East 34 Street, New York, NY 10016. Tel: 212-532-3200; Fax: 212-684-0832; Web site: http://www.mdrc.org.
PUB TYPE	Reports - Descriptive (141)
EDRS PRICE	MF01/PC04 Plus Postage.
DESCRIPTORS	*Academic Standards; *Algebra; *Educational Change; Educational Policy; Elementary Secondary Education; Equal Education; *Mathematics Achievement; *Mathematics Education; *Minority Group Children
IDENTIFIERS	*EQUITY 2000; *Milwaukee Public Schools WI

ABSTRACT

This paper describes the Milwaukee Public Schools' involvement in Equity 2000, a standards-based reform initiative to enhance mathematics education and achievement among students of color, thereby increasing their likelihood of college enrollment and completion. The study highlights efforts to support and sustain a key component of Equity 2000: districtwide policy change to end tracking and raise academic standards for all students, beginning with the requirement that all students complete algebra by 9th grade and geometry by 10th grade, and including curriculum reform to reflect National Council of Teachers of Mathematics standards. Section 1, "Introduction," presents key themes. Section 2 discusses "Equity 2000: Policy Rationale and Implementation in Milwaukee." Section 3 discusses "Increasing Student Achievement in Mathematics." Section 4, "Barriers to Student Achievement in Mathematics," discusses student attendance and preparation in mathematics, large class size and meeting diverse learning needs, and limitations on building teacher capacity. Section 5, "Getting to the Right Algebra," discusses algebra curriculum content, when algebra should be taught, and how algebra should be taught. Section 6 discusses "The Legacy of Equity 2000 in Milwaukee." Two appendixes offer the context of reform in Milwaukee's schools and other professional development math initiatives in Milwaukee Public Schools. (Contains 58 references.) (SM)

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Getting to the Right Algebra

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MDRC Working Paper

Getting to the Right Algebra

The Equity 2000 Initiative in Milwaukee Public Schools

Sandra Ham
Erica Walker

MDRC

April 1999

Manpower Demonstration Research Corporation

The development, production, and distribution of this report were made possible through the financial support of the Center for Research on the Education of Students Placed At Risk (CRESPAR), The College Board, and the Ford Foundation.

Dissemination of MDRC's work is also supported by MDRC's Public Policy Outreach Funders: the Ford Foundation, the Ambrose Monell Foundation, the Alcoa Foundation, and the James Irvine Foundation.

The findings and conclusions presented in this report do not necessarily represent the official positions or policies of the funders.

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Acknowledgments

The authors acknowledge with appreciation the generous contributions of time and information provided by Milwaukee Public Schools administrators, teachers, and guidance counselors. In particular, we thank Dr. Cynthia Ellwood, Ms. Mary Henry, Dr. Lynn Krebs, and Ms. Karen Villwock for their site-visit coordination and data collection assistance as well as their thoughtful comments on drafts of the paper. Additionally we thank staff at The College Board; Ms. Marlene Dunham in the Division of Teaching and Learning provided invaluable guidance over the course of data collection and production of the paper. We also thank Dr. Vinetta Jones, Executive Director of Equity 2000, and staff at the Equity 2000 National Office, particularly, Dr. Carol West, Dr. Larry Dolan, and Ms. Paula Kuebler, each of whom was tremendously helpful in providing background information on Equity 2000 implementation and in sharing data on student achievement trends in Milwaukee. We are grateful as well to Dr. Sylvia Johnson at Howard University and to staff at the Center for Research on the Education of Students Placed At Risk (CRESPAR), particularly, Michael Wallace, Dr. Gerunda Hughes, and Dr. Sheila Thompson, for the wonderful collaboration which provided the exploratory research premise for this paper.

At MDRC, Glee Ivory Holton provided overall management and guidance for field research, data analysis, and the production of the paper. Marilyn Price assisted in conducting interviews and focus groups and in analyzing data throughout the writing of this paper. Rochanda Jackson prepared the tables, and Gloria Diaz and Mona Grant transcribed the taped focus group sessions. Rob Ivry, Fred Doolittle, Jim Kemple, Janet Quint, and Susan Poglinco provided feedback and guidance in reviewing drafts of the paper. Robert Weber edited the paper, and Stephanie Cowell and Patt Pontevolpe prepared the manuscript for publication. To each of these colleagues, we extend our sincerest thanks.

I. Introduction

Equity 2000 is a standards-based reform initiative[1] aimed at enhancing mathematics education and achievement among students of color, thereby increasing their likelihood of college enrollment and completion (Pelavin and Kane, 1990). Early lessons on the implementation and outcomes of Equity 2000 have been documented in numerous evaluation reports. For the most part, these reports conclude that in districts where Equity 2000 was piloted, the general math track at the high school level has been virtually eliminated; the number of students who enroll in algebra, geometry, and higher-level mathematics courses has dramatically increased; and districtwide completion rates in Algebra I or higher at the ninth grade have doubled (Everson and Dunham, 1996; Pelavin Research Institute, 1996, 1997). Descriptive case studies on the early years of Equity 2000 implementation in the pilot districts have been produced as well (Richmond, 1996). Together, these reports provide a full picture of the process and outcomes of Equity 2000 during the initiative's pilot phase, from 1991 to 1996.

The focus of this paper is to describe what has transpired (both during and since the pilot phase) in one Equity 2000 district — Milwaukee Public Schools (MPS) — to support and sustain a key component of Equity 2000: "Districtwide policy change to end [low-level] tracking and raise academic standards for all students, beginning with the requirement that all students complete algebra by the ninth grade and geometry by the tenth grade, and including the reform of the curriculum to reflect standards set by NCTM [National Council of Teachers of Mathematics] and other discipline-based organizations" (The College Board, 1996, p. 1). In particular, the discussion presented in this paper centers on one central issue of the Equity 2000 initiative in MPS: student completion of Algebra I by the end of ninth grade.[2]

Since launching its Equity 2000 initiative, Milwaukee has tripled the percentage of ninth graders enrolled in Algebra I or higher-level mathematics courses, from 31 percent in 1991 to 99 percent in 1997.[3] Over this same period, Algebra I completion rates by the end of ninth grade have more than doubled, increasing from 25 percent to 55 percent.[4] In fact, more MPS students are now *passing* Algebra I than had ever attempted to take the course in years before Equity 2000. On the other hand, a consistent pattern over the implementation of this initiative has been

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[1]Equity 2000 espouses the philosophy that all students should be exposed to a mathematics curriculum that enables them to understand algebraic concepts by the end of ninth grade. This is consistent with standards developed by the National Council of Teachers of Mathematics (NCTM) in 1989.

[2]Milwaukee did not mandate tenth-grade Geometry enrollment at the launch of its Equity 2000 initiative, and thus we chose not to examine data or explore issues specific to tenth-grade completion in Geometry. It should be noted, however, that MPS high school graduation requirements to take effect with the Class of 2004 will require students to take three years of math beyond Algebra I.

[3]The ninth-grade enrollment and completion rates presented in this report are based on figures provided by the Pelavin Research Institute and The College Board. It was not within MDRC's scope of work to verify the accuracy of these data. We do know that in 1991 the calculation of student enrollment in Algebra I or higher was based on fall registration, and in 1997 enrollment was based on spring registration. In both cases, there were missing data for ninth-grade students who were not officially registered in any math courses. Interpretation of these data should be considered in this light.

[4]Completion of algebra should not be assumed as mastery, that is, students who pass Algebra I with a B+ or better. For MPS algebra achievement trends at the mastery level, see Pelavin Research Institute, 1997.

that nearly half the MPS ninth graders who enroll in Algebra I (an average of 47 percent) do not pass this course by the end of the school year. These achievement trends indicate the need to understand more about how large, urban school systems can best use standards-based models, such as Equity 2000, to promote mathematics achievement for all students. With this context as a backdrop, the paper addresses three central questions:

- What factors might account for the dramatic increase in the completion rate for ninth graders who enroll in Algebra I or higher?
- What issues might account for the 47 percent of ninth-grade students who do not pass Algebra I?
- In what ways have these mathematics achievement trends influenced algebra curriculum and instruction in MPS?

Key Themes of the Paper

The following statements highlight the key themes presented and the issues raised in this paper.

In Milwaukee, Algebra I completion has become a universal expectation for all students by the end of ninth grade, and other components of Equity 2000 appear to be institutionalized as well.

- *MPS has stuck to its commitment to enroll all ninth-grade students in Algebra I since launching its algebra-for-all mandate in September 1993.* The algebra-for-all mandate has been sustained across several changes in the district leadership. MPS educators attribute this staying power to the broad-based involvement of teachers, guidance counselors, and administrators in training for and implementing this policy; to the ongoing support and technical assistance of The College Board; and to the belief that students are willing and able to "rise to the occasion" when presented with the opportunity to learn at high standards. The MPS policy statement on this mandate indicates that the only ninth graders excluded from Algebra I enrollment are students who have already earned algebra credit in middle school and those students whose individual education plans dictate otherwise. Within two years of the mandate, low-level, general math courses such as Applied Math I were eliminated from the high school math curriculum, and after four years, findings show that more MPS students are passing Algebra I by the end of ninth grade than had even attempted to take this course before Equity 2000 was introduced.
- *MPS educators credit the Equity 2000 professional development approach as a key factor in fostering implementation of the algebra-for-all mandate.* The Equity 2000 professional development model engages a cross-section of education stakeholders including teachers, guidance counselors, and principals. The Equity 2000 professional development consists of summer institutes and follow-up in-service during the school year. MPS estimates that approximately 85 percent of

grade 8-10 math teachers in the district participated in some level of Equity 2000 training. Teachers tended to agree with this estimate, while principals reported lower participation rates and cited high staff turnover as an impediment to keeping trained teachers. Lessons from the Milwaukee experience show the value of Equity 2000's comprehensive professional development delivery model toward building school staff support for the algebra-for-all mandate. Teachers, in particular, felt that by starting Equity 2000 professional development months before the mandate was to take effect, they were better able to understand, prepare for, and adjust to the policy itself and to changes that would result. Although Equity 2000 professional development incorporated issues of content (what we teach), pedagogy (how we teach), and equity (who we teach), comments from MPS educators suggest that the initiative had more impact on attitudes about students' capabilities and on the pedagogy for delivering instruction than it had on strengthening teachers' content knowledge. When MPS assumed total responsibility for costs to sustain Equity 2000 professional development in 1996, the intensity of Equity 2000 summer institutes and the frequency of the follow-up in-service were scaled back. However, the district appears to have institutionalized these activities by blending training into existing classroom-based learning experiences and by securing other grant-funded math initiatives. The Milwaukee Urban Systemic Initiative (MUSI), which is funded through a comprehensive five-year grant from the National Science Foundation (NSF), was most notably acknowledged as an invaluable resource for extending and deepening the scope of professional development around mathematics curriculum reform. The proliferation of teacher-to-teacher math networks within the district has also emerged as a key source of professional development by sustaining dialogue around issues supportive of Equity 2000 goals.[5]

- *Implementation of the algebra-for-all mandate depended on the willingness and ability of MPS math teachers and guidance counselors to change their practice in innovative ways.* The importance of retooling practice was cited repeatedly in interview and focus groups with teachers, guidance counselors, and administrators. This theme was supported by documentation compiled in the MPS Equity 2000 audit reports. From these data sources, we identified that, over the years since Equity 2000 was first launched, Algebra I teachers have increased their use of group work and cooperative learning techniques, real-world application of math concepts, and calculators. Teachers talked not only about the influence that Equity 2000 had on their classroom practice but also about its effect on collegial exchange: more instances of teachers using other teachers as a resource. In addition, guidance services have been expanded as a result of Equity 2000. MPS guidance services now give more attention to introducing students at an earlier age to postsecondary opportunities, to increasing college campus exposure for potential first-generation col-

[5] The establishment of MPS math teacher networks initially emerged from the Equity 2000 initiative, and their proliferation has been supported through MUSI and other federal funds.

lege-bound students, to encouraging all students to enroll in advanced-level courses, and to working collaboratively with teachers and parents to help students understand the importance of mathematics in securing an array of post-secondary options.

- *MPS created a variety of safety net activities to provide academic enrichment and extra support in mathematics; however, MPS educators cite the continuing challenge of motivating students to take advantage of these safety net opportunities.* MPS implemented several of the safety net support strategies that were encouraged under the Equity 2000 model. The Saturday Academy program offers enrichment in mathematics and science, college exposure, and parental involvement. The math summer school program, which targets low-performing students, provides a range of academic supports for students in grades 8-12 including Algebra Readiness classes, make-up classes for students who fail Algebra I or Geometry, and (since 1996) classes to prepare for the high school math proficiency examination. School-based academic support is provided through tutoring, algebra support classes, and midyear Algebra I reprogramming courses.[6] The safety net support structures that MPS has established through its Equity 2000 initiative have the potential to serve a substantial number of students. However, because student participation in many of these safety net activities is optional, teachers report that for various reasons (program location, competing demands with other courses, or lack of motivation) participation is lower than desired. Teachers also pointed out that several MPS high schools had recently adopted block scheduling as a strategy to improve overall student academic performance. *Block scheduling* provides students more time to learn math (and other subject areas) within the *required* school curriculum. Both teachers and administrators tended to view block scheduling as an additional safety net (although in some cases, it was reported that block scheduling hampered the school's ability to offer midyear reprogrammed Algebra I courses). Nonetheless, issues of student motivation and incentives are important to address if the benefits of safety net activities are to outweigh their costs.[7] If data are not available, the district's investment in such activities warrants a closer look: For which students, and in what ways, are these safety nets successful in increasing achievement in Algebra I and other measures of high standards in mathematics? Any future research on Equity 2000 should serve to look more closely at this issue.

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[6]In MPS, Algebra I traditionally operates as a full-year, two-semester course. Students who fail the first semester may be "reprogrammed" to take this section of the course over again instead of continuing with the second semester of algebra, which they are also likely to fail. Students who are reprogrammed and pass the first-semester section in the spring then have the option of taking second-semester Algebra I in summer school or during the following school year.

[7]MDRC was not able to obtain documentation from MPS on the impact of student safety nets, that is, to what degree safety net activities increased Algebra I completion or whether students who participated in safety nets had higher levels of mathematics achievement than a similar group of students who did not.

- *MPS has sustained its commitment to the core principles of Equity 2000, absorbing the incremental costs locally now that the pilot phase is over.* Eight years after being introduced in Milwaukee, Equity 2000 components appear to have attained a visible and sustained presence within MPS' overall school improvement priorities. In fact, the Equity 2000 National Office assisted MPS (as well as the other Equity 2000 pilot districts) in the development of an "institutionalization plan" that enabled the district early on to prepare for carrying implementation beyond the initial, five-year Equity 2000 grant. Information collected by MDRC during the 1997-98 school year indicates that costs related to ongoing implementation of the major components of Equity 2000 (that is, professional development, safety nets, parental involvement, college and university partnerships, and data analysis) are funded locally or through other leveraged resources. District institutionalization of Equity 2000 appears to extend beyond the algebra-for-all mandate, professional development, safety net supports, and parental involvement activities. An MPS official pointed out that "in an era of accountability," Equity 2000 emphasis on dissaggregating student data helped to reinforce careful examination of student achievement trends. Because of Equity 2000, Algebra I passing rates are included as a performance measure for annual school accountability reports compiled by the MPS Office of Research and Assessment. Disaggregated trend data on student participation in advanced-placement courses, college entrance examinations, and college enrollment have been compiled annually since 1992. Similarly, MPS partnerships with local institutions of higher education have been strengthened through such initiatives as Equity 2000 and MUSI. In particular, the University of Wisconsin-Milwaukee and Marquette University are central partners in the MPS reform efforts in that they provide a wealth of resources, expertise, and professional growth opportunities focused on mathematics teaching and learning. The ongoing role and eventual legacy of Equity 2000 as expressed by MPS educators reflect a perception that this initiative has played a pivotal role in actualizing high standards, not only in mathematics but across other subject areas as well.

Despite the substantial increase in Algebra I completion within the district, MPS educators are very concerned that nearly half the ninth graders who enroll in Algebra I do not pass by the end of the school year.

- *Several barriers to student achievement in mathematics were cited; foremost among these are poor student preparation in math and low student attendance.* Teachers (and other respondent groups) indicated that an overwhelming number of ninth graders were not prepared academically to take on the rigors of Algebra I. Teachers reported that they had revised the pace of the Algebra I curriculum — some feel to a "watered-down" state — in order to accommodate the limited amount of material that students could absorb. The perceived lack of student preparation was largely attributed to two factors: the middle school math curriculum and poor content knowledge of middle school math teachers, although some attributed such perceptions about poor student

preparation to low teacher expectations or teachers' inability to engage students in the learning process. There was general consensus, however, that the average daily absentee rate of 25 percent largely contributed to the high number of students who had to repeat Algebra I one or more times. Concern about how to monitor and best serve the needs of "repeater" students emerged as a major issue. It may be worthy of study to identify and review the types of reassignment or instructional strategies that are used with this population to determine how best to raise math achievement among repeaters.

- *A second reported impediment to student achievement in Algebra I is large class size and its impact on teachers' ability to meet the diverse learning needs of a heterogeneous classroom.* With the elimination of low-level math courses, the grouping of students based on ability has been greatly reduced in the ninth-grade mathematics curriculum but not totally abolished. A comparative review of the 1994 and 1997 MPS Equity 2000 audit reports showed that high schools have dropped courses such as Chapter I Algebra, but most continue to offer a gifted and talented Algebra I class.[8] Teachers and guidance counselors report that the majority of ninth-grade students are assigned to "regular" Algebra I classrooms, which thus serve a wide range of students with varying academic skills and capabilities. Teachers admit that they struggle to address the different skill levels and learning styles of their Algebra I students. This challenge is compounded by the reported size of Algebra I classes, which average from 30 to 35 students (largely reflecting a districtwide math teacher shortage). In trying to respond effectively to this challenge, teachers report that they are using such techniques as math manipulatives and cooperative learning. However, to better accommodate the diverse learning needs of students, teachers and administrators advocate the need to provide different Algebra I curriculum options. Sentiment in MPS around the possibility of offering algebra curriculum options may yield opportunities for future research on alternative approaches to ability grouping.

- *A third major barrier to student achievement in Algebra I are the limitations on building teacher capacity to implement the algebra-for-all mandate.* Despite the high percentage of math teachers who participated in Equity 2000 professional development, it appears that the level and intensity of involvement were not the same for all teachers. Costs for professional development in MPS are very high, limiting the number of participants who can be served at any given training session. Priority for these limited slots was given based not on teaching assignment (that is, teachers who were teaching algebra) but rather on years of teaching experience.[9] Even with professional development,

[8]MDRC was not able to determine whether this trend was more a reflection of the 1994 reauthorization of Title I, which resulted in an increase of schoolwide Title I programming, or more directly related to the Equity 2000 objective to de-track all students.

[9]The MPS teachers' union agreement was a key influence on both the cost for professional development and the determination of participants.

MPS educators indicate that low teacher expectations, lack of access to needed resources, and resistance to change further served to hinder student achievement in algebra. In regard to teacher expectations, perceived gains in this area were somewhat mixed. While the majority of comments on this issue reflected a perception that the tide of low expectations for all students learning algebra had receded, there were others who thought the belief that "algebra is not for everyone" widely persisted within the teaching ranks. Regarding access to resources and teacher resistance to change, both teachers and administrators felt that Equity 2000 training should be followed up with classroom based support and monitoring to (1) ensure that instructional resources are available in each school and (2) help teachers practice, develop a comfort level, and feel accountable for implementing new practices that Equity 2000 espouses for working with diverse groups of students. It was noted that the MPS math and science resource teachers (MSRTs) — a core of veteran classroom teachers who were hired in 1996 to serve as resource teachers for the district — represent a step toward addressing these needs.[10]

MPS is committed to building on the early accomplishments of Equity 2000 by making additional policy and practice changes to enhance student achievement trends in Algebra I.

- *For the first time in over a decade, a district-issued Algebra I curriculum guide for high schools has been developed.* Several factors in the district — MUSI, the algebra-for-all mandate, concerns about a watered-down Algebra I curriculum, and the advent of math proficiency standards and assessments — prompted MPS high school principals to request that the district provide a specific algebra curriculum, including scope and sequence. In January 1998, an Algebra Curriculum Committee — comprising math and science resource teachers, middle and high school math teachers, and university faculty — was formed to develop the curriculum guide. The MPS *Algebra I Guide: For Heath Algebra I* was completed in July 1998, and distribution was accompanied by a series of in-services that provided "how to" information on its use. The guide embraces the shift from topic-driven and teacher-focused instruction to concept-based and student-centered methods, and it includes a framework for what an algebra class should look like. The guide reflects efforts that are being mounted at multiple levels throughout the district to meet the diverse learning needs of students and to better prepare students for the rigors of advanced mathematics courses at the high school level.

- *All MPS middle schools are implementing a standards-based middle school math curriculum to develop student proficiency in mathematics.* When MPS adopted Equity 2000, the eighth-grade mathematics curriculum was changed to "prepare all students with the mathematics foundation they will need to succeed in high school algebra and geometry" (Talborn, 1991, p. 14). The

[10]The work of MSRTs is funded and operates through MUSI.

district adopted the ScottForesman textbook series *Exploring Mathematics* and *UCSMP Transition Mathematics* for the eighth-grade mathematics course; sixth- and seventh-grade mathematics courses remained unchanged. Sparked largely by the district's work through MUSI — and the aforementioned teacher concerns about the lack of student preparation in mathematics — Milwaukee is again in the process of changing the mathematics curriculum at the middle school level through the adoption of the Connected Mathematics Project (CMP), an NSF-supported curriculum which introduces algebraic concepts *throughout* grades 6-8. By the year 2000, a set of math proficiency assessments for eighth graders (along with other content area proficiency assessments) will serve as a filter to, in effect, end social promotion and ensure that all incoming ninth graders are prepared to take higher-level mathematics courses.[11] Strengthening math content knowledge among middle school teachers has been identified as a key priority for effective implementation of the CMP curriculum. The district is providing teacher training in CMP through its Milwaukee Urban Systemic Initiative, and recently the Equity 2000 summer institutes have focused on CMP training for middle school teachers as well.

- *Alternative approaches to algebra curriculum sequencing and instruction are being piloted across MPS high schools.* At the high school level, many schools are piloting and adopting alternative algebra curriculum programs such as the Pittsburgh Urban Mathematics Program (PUMP) and integrated math curriculum programs such as the Core-Plus Mathematics Project (CPMP) and the Interactive Mathematics Program (IMP). These programs extensively use the instructional techniques of student discussion through word-based problem solving and student group work. Technology is also an integral part of each program. CPMP and IMP differ as well from the "topical learning" found in traditional mathematics courses by providing an integrated approach to problem solving that builds on students' prior math knowledge to introduce new concepts. These integrated math programs cover the sequence of algebra, geometry, and (in the case of IMP) advanced math over a two- to four-year period. MPS high schools are using these technology-based and integrated curriculum alternatives in addition to the traditional course sequence of Algebra I and more advanced math. It remains to be seen how these curriculum and instructional changes will impact on math achievement and other education outcomes. Some MPS educators worry that the new integrated and technology-based algebra curricula may not provide adequate foundation for students to master algebra and geometry and do well in more advanced mathematics coursework. There is also concern that the integrated math curriculum programs may not align with local accountability assessments. Advocates of the new math curricula, however, believe strongly that students who complete the integrated math programs will develop the same level of skills

[11]As reported later in this paper, some MPS educators are concerned about what will happen to students who do not pass the eighth-grade proficiency assessments.

(or a higher level) as students who successfully complete the traditional route. Certainly, Milwaukee provides fertile ground for putting these issues to the test. A study of the effects of the new curricula would be particularly timely, given that The College Board has developed an end-of-year Algebra I assessment which could serve as the standard tool for evaluating the rigor of all approaches to algebra instruction, including the traditional one-year Algebra I course.

- *Equity 2000 appears to have had direct and indirect influences on current efforts in MPS to stay the course for actualizing high standards in mathematics.*[12] Clearly, teachers feel that Equity 2000 strongly challenged traditional mind-sets about the capacity of all students to learn algebra and influenced their pedagogical techniques for engaging students in classroom work. However, it was also reported that the Equity 2000 design had fallen short in providing specific programs teachers felt they needed in order to reform the math curricula substantively and better meet students' diverse needs. Equity 2000 espouses a learning paradigm approach that focuses on how students learn best, whereas the traditional instructional paradigm focuses on content coverage in the classroom. Enabling teachers to make the paradigm shift requires sustained energy, administrative support, time and other resources, and alignment between curriculum and accountability assessments. Through the continued commitment of MPS educators toward high standards and the synergy of curriculum-based initiatives such as Equity 2000, School-to-Work, and MUSI, current efforts to adopt new math curricula programs, to develop curriculum standards and new proficiency assessments, and to provide math resource teachers *may* result in bridging the gap between learning and instructional paradigms. A clear lesson from the Milwaukee experience is that efforts to reform and align students' needs, teachers' practices, the curricula, and methods of assessment require a long-term commitment and multiple sources of support that are linked to a common vision of teaching and learning.

Description of the Paper

Six years after MPS first adopted the Equity 2000 initiative and four years after the district's algebra-for-all mandate was put into effect, MDRC conducted a preliminary review of implementation issues surrounding a central component of the Equity 2000 initiative in Milwaukee Public Schools (MPS) — student completion of Algebra I by the end of ninth grade. We acknowledge that the goals of Equity 2000 extend beyond this objective and include increased tenth-grade enrollment in Geometry as well as overall enrollment in advanced courses, increased percentages of minority students who take college entrance examinations, and increased minority students' college enrollment rates. Among Equity 2000 districts, achievement trends in these ar-

[12]MPS educators reported that Equity 2000 served to influence high standards reform in other subject areas as well.

eas have been well documented in numerous Equity 2000 reports and evaluations.[13] As such, the focus for the remainder of this paper is as follows:

- Section II provides background on the education policy context and program rationale from which Equity 2000 was created and also presents an overview of the Equity 2000 implementation design.
- Section III reports The College Board's data on ninth-grade student enrollment and passing rates in Algebra I for Milwaukee and describes the steps that were taken in Milwaukee to support implementation of Equity 2000 components and to raise student achievement in Algebra I.
- Section IV presents information on the perceptions among MPS educators about challenges they face in getting all students to complete Algebra I by the end of ninth grade.
- Section V describes recent efforts within and across MPS middle and high schools to revise the content, delivery, and sequence of algebra instruction to increase student achievement in mathematics.
- Section VI provides a closing statement on the perceived legacy of Equity 2000 in Milwaukee Public Schools.

[13]For findings on these broader issues of Equity 2000, see Pelavin Research Institute, 1997.

II. Equity 2000: Policy Rationale and Implementation in Milwaukee

> *Algebra for all is the right goal at the right time. We just need to get the right algebra.*
>
> Chambers (1994, p. 86)

Standards reform in education policy has sparked a number of efforts at the national, state, and local levels to articulate exactly what students should know and be able to do in particular content areas at different grade spans along the K-12 curriculum. One content domain that has emerged as the leader in building consensus around standards is mathematics. In 1989, the National Council of Teachers of Mathematics (NCTM) issued its *Curriculum and Evaluation Standards for School Mathematics*, becoming the first national teacher association to endorse a specific set of curriculum standards.[14] In this groundbreaking document, NCTM suggested that the change from an industrial to an information society called for a revamping of mathematics education in order to adequately prepare *all* students for life in the twenty-first century. Indeed, NCTM asserted that "women and most minorities" were underrepresented in careers in mathematics, science, and technology and that "the social injustices of past schooling practices can no longer be tolerated" in a society in which mathematics is "a critical filter for employment and full participation" (NCTM, 1989, p. 4). The NCTM standards received widespread support among mathematics educators and also served to influence standards development efforts in other disciplines. The movement toward standards has been manifested in a proliferation of changes in high school graduation requirements, curriculum design and sequencing, and student assessment (Bradley, 1994; Century, 1994; Rothman, 1995).

In the area of mathematics, algebra-for-all has become a rallying cry for high-standards curriculum reform (Chambers, 1994; NCTM, 1993). Based on research findings that support the importance of algebra enrollment as a predictor for academic and vocational success and its designation as a gatekeeper to educational opportunity and lifelong success (NCTM, 1989; Pelavin and Kane, 1990), algebra has been singled out as a vanguard for high standards. This push for algebra is particularly relevant for minorities. Oakes (1990) and others (Equity Coalition, 1992; Southwest Educational Development Laboratory, 1994; Trimble and Sinclair, 1988) have extensively documented the underrepresentation of black and Latino students in higher-level mathematics classes for which algebra and geometry are prerequisites. Thus, the move to high standards as exemplified by Equity 2000 is touted as a viable mechanism to level the mathematics playing field. In the past 10 years, several states and school districts have adopted an algebra-for-all policy, either as a high school graduation requirement or at a targeted grade level, usually ninth grade (Bradley, 1994; Chambers, 1994; Olson, 1994; Silvers, 1995). National mathematics reform initiatives such as Equity 2000 and the Urban Systemic Initiative (funded by the National Science Foundation) helped to fuel this pattern by providing grants to urban districts that promised to make algebra a requirement for all students by the end of ninth grade.

Some in the mathematics community caution, however, that algebra-for-all — absent changes in algebra curriculum design, sequencing, and delivery — is a doomed response to high

[14]NCTM is currently rewriting the standards to be released in the year 2000.

standards (Chambers, 1994; Steen, 1992). Leading mathematics educator Edward Silvers argues that algebra requirement policies may not be leading to high standards at all but may simply be "mandating mediocrity." In a 1994 *Education Week* article, then NCTM president Jack Price raised a similar concern that districts may approach an algebra-for-all policy simply by placing all students (at the eighth or ninth grade) in "what we might call a traditional first-year algebra class . . . a course in high school that is currently a filter for higher mathematics" instead of rethinking the learning process of algebraic concepts as "a strand [to be woven] throughout the K-12 curriculum" (Olson, 1994, p. 13). Researchers from the U.S. Department of Education found that in other countries algebra, geometry, and probability are traditionally introduced to students starting in grade 5, while "U.S. students are still stuck in arithmetic, moving onto algebra and other topics only in the 8th or 9th grades, if they do so at all" (LeTendre and Chabran, 1998, p. 8). As a result, the transition from middle school math to high school algebra is difficult. These researchers further conclude that the transition is particularly difficult for minority and poor students, because they are least likely to have had sufficient preparation in the basics of math that would enable them to surmount such a challenge.[15] This is not to say that math educators who raise these concerns do not support the algebra-for-all philosophy. However, cautions issued around such policies may be more in line with the sentiment of Donald Chambers, who in an article entitled "The Right Algebra for All" wrote: "Algebra for all is the right goal at the right time. We just need to get the right algebra" (1994, p. 86).

Equity 2000

The College Board created Equity 2000 in 1990. By increasing the enrollment of students of color in higher-order mathematics courses, Equity 2000 aims, ultimately, to increase their overall academic achievement and college attendance rates. A major goal of this initiative is to close the achievement gap between minority and non-minority and between advantaged and disadvantaged students. Equity 2000 is based on the premise that all students can learn and on research indicating that low-income, minority students — when they master algebra and geometry by the end of tenth grade and have expectations to attend college — tend to enroll in college at about the same rate as their non-minority or more economically advantaged peers (Pelavin and Kane, 1990).

Equity 2000 provides districts with "a process" to foster a high-expectations learning environment for all students by focusing on access to and achievement in Algebra I and Geometry for students who normally would not enroll in these courses. Equity 2000 is a districtwide education reform initiative that seeks to influence systemic changes by eliminating low-level courses in the ninth- and tenth-grade mathematics curriculum, providing ongoing professional development for school staff, developing safety net activities that provide academic enrichment and extra support, increasing parental involvement in student learning, building school-community partnerships, and fostering a high-expectations learning environment through dialogue and examination of student subgroup achievement trends.

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[15]LeTendre and Chabran cite that in high-poverty schools less than half the math teachers hold licenses or degrees in that subject, which negatively affects the quality of instruction.

In adopting Equity 2000, a participating district's commitment extends far beyond algebra and geometry enrollment mandates. The district also signs on to provide the capacity-building supports needed to implement the remaining five central components of Equity 2000, which are:

- *Professional development for teachers, guidance counselors, and principals* — to enhance their professional knowledge and skills and to raise their expectations for students
- *Safety net academic enrichment programs for students* — to increase their motivation and confidence about math
- *Programs to support parent/family involvement* — to help parents and their children understand and get involved in the push for higher standards
- *Programs linking school districts, colleges and universities, and the local community* — to develop and strengthen support of high-standards learning goals
- *Programs to evaluate Equity 2000 objectives* — to help districts and schools effectively examine disaggregated student enrollment and achievement data to enhance school-improvement decision making

Although Equity 2000 supports and encourages teacher practice in alignment with NCTM standards, the initiative does not endorse nor does it suggest adoption of specific mathematics curricula. Rather, Equity 2000 seeks to promote the use of NCTM standards by helping districts to obtain information on best practices through cross-site sharing and other math educator networking activities. These building blocks may (but do not necessarily) lead districts to recognize the need for more comprehensive curricular changes.

Equity 2000 Implementation in Milwaukee

In 1991, Milwaukee Public Schools (MPS) became one of six pilot sites of the Equity 2000 initiative[16] and, in the 1993-94 school year, adopted the policy to enroll all ninth graders in Algebra I. This decision represented one in a continuum of policy adoptions made by MPS during the 1990s to increase academic expectations and achievement for all students.[17] As an Equity 2000 pilot district, MPS received a $1,936,248 five-year grant from The College Board.[18] In accordance with the memorandum of understanding agreed to by the pilot districts, The College Board grant funded the salary of a full-time MPS Equity 2000 coordinator, professional development (including trainers and participant stipends), student safety net activities, travel expenses

[16]The other Equity 2000 pilot sites are Fort Worth, TX; Providence, RI; Nashville, TN; Prince George's County, MD; and San Jose, CA (the San Jose site comprised a consortium of nine districts). The pilot sites represent 700 schools which serve nearly half a million students.

[17]See Appendix A for a more detailed description of MPS' reform context.

[18]The pilot phase spanned a five-year period beginning for some districts in 1990 and for others in 1991.

to Equity 2000 meetings, and other planning activities. Milwaukee was required to leverage some degree of matching funds and in-kind support as well.[19]

Along with the grant, MPS received ongoing technical assistance from The College Board.[20] Technical assistance provided by The College Board during the pilot phase served to develop and/or strengthen local capacity for (1) establishing professional development delivery systems around high-standards reform in mathematics, (2) providing safety net academic support activities to help students succeed and get parents involved, (3) building partnerships with local institutions of higher education focused on mathematics teaching and learning, (4) compiling and analyzing student achievement data to ensure that all populations of students have access to and are making progress in achieving at high levels, and (5) developing institutionalization plans for reallocating and leveraging local funds to support ongoing implementation of Equity 2000 components. In addition, the Executive Director of the Equity 2000 National Office visited MPS twice a year to provide on-site guidance, observe Equity 2000 activities, and meet with local education policymakers. National technical assistance committees (one for mathematics and one for guidance) were also established to develop guidelines for Equity 2000's professional development delivery model. Probably the most comprehensive component of the technical assistance effort was provided through the national network support meetings that were hosted by the Equity 2000 National Office, which served to bring representatives from MPS and other pilot districts together to share ideas and learn from leading mathematics education experts. Specialty group network meetings were conducted three or four times a year for Equity 2000 coordinators, math curriculum specialists, guidance directors, and data managers.[21] District superintendents and school board members attended network meetings twice a year. Principals also attend Equity 2000 network meetings. MPS participants of the Equity 2000 national networks highly regarded these meetings as instrumental in keeping local leaders of the initiative "energized . . . focused . . . [and] informed."

From 1991 to 1997, a full-time MPS Equity 2000 coordinator handled day-to-day management and budget responsibilities for the initiative.[22] In August 1997, the coordinator became director of the Milwaukee Urban Systemic Initiative while continuing management responsibility for Equity 2000. (A math teacher is released part time to assist in the coordination of Equity 2000 activities.) Since its inception, a *core planning team* composed of the Equity 2000 coordinator, math curriculum specialist, and guidance director has met regularly to design and plan Equity 2000 activities. In addition, an "extended leadership group" comprising principals, MPS research staff, and two University of Wisconsin-Milwaukee faculty members meets with the core

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[19]Each year of the pilot phase, The College Board grant decreased while MPS' funding contribution to Equity 2000 increased.

[20]The College Board established an Equity 2000 National Office to oversee development of the Equity 2000 initiative.

[21]The national network meetings were conducted more frequently during the pilot phase of Equity 2000. Currently, teams of representatives from Equity 2000 districts are convened twice a year for national network meetings.

[22]Albert Taborn served in this capacity from 1991 to 1993. Mary Henry became MPS' Equity 2000 coordinator in September 1993.

planning team twice a year to advise the overall project.[23] A math teacher (who serves part time as Equity 2000 coordinator) joined the leadership group in the fall of 1998.

In June 1996, MPS became a demonstration district for Equity 2000.[24] Since the fall of 1996, MPS has been the recipient of the five-year demonstration grant of $50,000 annually from The College Board. MPS continues to participate in national network meetings (held twice a year) and has assumed a lead role in providing training and presentations on lessons learned from Equity 2000 implementation to staff from new Equity 2000 adoption sites.[25] MPS also hosts visits from and conducts visits to districts interested in adopting Equity 2000 and (where requested) has provided technical assistance to these sites. The Executive Director of the Equity 2000 National Office continues to visit MPS once a year to review progress and provide technical assistance on implementation of the district's Equity 2000 institutionalization plan.

MDRC's Preliminary Review of Equity 2000 in Milwaukee

During the 1997-98 school year, MDRC conducted a preliminary review of Equity 2000 implementation in Milwaukee.[26] This preliminary review had three purposes:

1. To understand how the implementation of Equity 2000 has evolved over time, including the level of institutionalization achieved for specific components of the initiative
2. To gather staff insights on factors that affect student achievement in Algebra I
3. To identify alternative approaches that have been adopted by schools since 1991 to help all students achieve at high levels in mathematics

The preliminary review was conducted over a 10-month period, during which time MDRC researchers visited MPS three times (November 1997, May 1998, and July 1998). The following sources provided data and information presented in this paper:

- In-person interviews with MPS central office administrators and teachers involved with the planning, coordination, and evaluation of Equity 2000 activities
- Interviews with four high school and two middle school principals

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[23]In addition, individual members of the core planning team meet regularly with mathematics teachers and guidance counselors to solicit input and feedback on Equity 2000 activities.

[24]Following completion of the pilot phase (and based on promising results from the Pelavin Research Institute's evaluation of Equity 2000), a national launch of the initiative was announced by The College Board in November 1996 (The College Board, 1996). The national effort earmarked the start of the demonstration and national dissemination phase of Equity 2000.

[25]MPS staff who serve as trainers receive a $200 per diem stipend.

[26]The initial purpose of this preliminary review was to inform MDRC's proposed three-year study of "alternative pathways" for promoting student success in math. This proposal was not funded. However, issues that emerged from the preliminary review are documented here for future research considerations.

- Focus groups with high school math teachers and phone interviews with middle school teachers. (A total of 38 teachers from 11 high schools and two middle schools participated.)
- Focus groups with nine guidance counselors, representing five middle schools and four high schools
- Phone interviews with staff at The College Board
- Collection and review of extant data and reports on Equity 2000 efforts in Milwaukee and nationally

MDRC conducted exploratory research on the evolution of Equity 2000 in Milwaukee and the implementation of the algebra-for-all mandate. Researchers used a reduced interview series to gather information from a select group of individuals who shared the common experience of being integrally involved with the planning and implementation of Equity 2000.[27] These individuals participated in in-depth interviews (or focus groups) lasting one or two hours. Where permitted, the focus group conversations were taped and transcribed. After each site visit, interview notes were coded to extract themes which served to inform and direct subsequent field interviews. MDRC also used a variety of independent evaluation data on Equity 2000 in Milwaukee and nationally to supplement the "voices from the field." This analysis process enabled the creation of several propositions about Equity 2000 and factors that support or inhibit the achievement of high standards in mathematics for all students. Unless otherwise indicated, all comments attributed to MPS educators as presented in this paper are based on the interviews and focus groups that were conducted during the preliminary review.

[27]MDRC modeled a reduced version of the interview series design recommended by Seidman (1991).

III. Increasing Student Achievement in Mathematics

> . . . *Beginning in September, 1993, all 9th grade students will be enrolled in algebra.* . . . Clearly, this is a mandate for us as a district, but implementation cannot be relegated simply to a policy change. Each school needs to assure that safety nets are in place to assist students who will have difficulty in achieving this goal. . . . A great deal of discussion about how to implement such an effort has already taken place among principals, teachers, and counselors involved in Equity 2000. . . . During the rest of this year and in coming years, we will intensify these conversations and plans as we work together to enable a smooth transition.
>
> — Memo to middle and high school principals from then-MPS Superintendent Dr. Howard Fuller, December 7, 1992

With this charge, Milwaukee Public Schools became the first Equity 2000 pilot site to put an algebra-for-all policy into effect (Pelavin Research Institute, 1997), thus dramatically increasing the number of students who enroll in and complete Algebra I. The College Board reports that ninth-grade enrollment in Algebra I or higher in MPS tripled (from 31 percent to 99 percent) between 1991 and 1997. For students of color, the increase has been most significant. Among black, Hispanic, and Asian, students enrollment rates increased 75, 78, and 67 percentage points, respectively. The total percentage of MPS students who completed Algebra I or higher-level math courses by the end of the ninth grade has more than doubled since Equity 2000 was launched, increasing from 25 percent to 55 percent between 1991 and 1997. This increase was significant across all ethnic groups, although the achievement gap between minority and non-minority students (with the exception of Asian students) remains significant. When we examine only the data on ninth-grade students enrolled in Algebra I, passing rates actually declined from 1991 to 1997, from 71 percent to 53 percent. It is important to note, however, that the absolute numbers of students taking algebra have increased substantially; thus, such a decline (though by no means acceptable according to MPS standards) might not be unexpected during early implementation years of such initiatives. Nonetheless, a frequently touted outcome of Equity 2000 (both nationally and within MPS) is that the number of students now passing Algebra I is greater than the number of ninth graders who even attempted to take this course in years before the initiative.

This section of the paper highlights other key activities that resulted from Equity 2000 and which sought to increase the levels of Algebra I completion by the end of ninth grade. These activities include (1) professional development to support implementation of the algebra-for-all mandate, (2) retooling of math teachers' classroom practices, (3) student safety net academic enrichment and support activities, and (4) the expanded role of guidance services in promoting high expectations for all students.

Equity 2000 Professional Development in Milwaukee

Like many reform efforts, successful implementation of Equity 2000 requires schools to adopt new modes of professional practice and interactions among colleagues and with students. In particular, teachers are expected to master new skills, deepen their content knowledge, and

change their classroom practices. Research indicates that, in order to meet these new demands, teachers will need "more time to work with colleagues, to critically examine the new standards being proposed, and to revise curriculum [and have] opportunities to develop, master, and reflect on new approaches to working with children" (Corcoran, 1995, p. 1).

Equity 2000 professional development consisted of intensive summer institutes and follow-up in-service during the school year. For teachers and guidance counselors, the institutes began in the summer of 1991, two years before the algebra-for-all mandate was put into effect. For principals, Equity 2000 summer institutes started in 1993. During the pilot phase, Equity 2000 summer institutes for teachers ran for two weeks, eight hours a day. Summer institutes for guidance counselors ran for one week, and those for principals were conducted over two days. There was some overlap in scheduling the institutes in order to bring each participant group (high school and eighth-grade math teachers, guidance counselors, and principals) together for cross-cutting general sessions. The University of Wisconsin-Milwaukee (UWM) was and continues to be a major partner in the design and implementation of the summer institutes. Many of the institute sessions are held on the UWM campus, and UWM faculty served as institute trainers/facilitators early on to develop turnkey trainers among MPS teachers.

The Equity 2000 institutes sought to raise awareness about how adults' expectations affected students' views of themselves, their attitudes about school, and their academic performance. These institutes also focused on the gatekeeping role of algebra, the disaggregation of student data, and other equity issues. The guidance institutes, in particular, focused on how to prepare first-generation college-bound students for successful transition into college. Consistent with the Equity 2000 professional development delivery model, teacher institutes regularly incorporated issues of content (what we teach), pedagogy (how we teach), and equity (who we teach). The institutes provided a forum for dialogues about NCTM standards, "Big Ideas" in curriculum content relating to the integration of algebra and geometry, and pedagogical techniques for delivering instruction to diverse learners. During the school year, teachers could sign up for an additional 20 hours of follow-up "rotisserie" workshops that were tailored to address different levels of content knowledge and familiarity with innovative instructional approaches.[28] Follow-up in-services were also provided for principals and guidance counselors.

Administrators and teachers were very favorable in assessing Equity 2000's professional development activities. Teachers reported that Equity 2000 was the first districtwide professional development initiative that focused on math teachers.[29]

> *The institutes were content rich with lots of hands-on activities. They had heavy emphasis on the use of calculators and manipulatives.* (Institute facilitator)

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[28]The number of follow-up in-service hours was reduced in 1996, when the workshops were folded into the Saturday Academy. Reasons for the change are described later in this section.

[29]In 1996, the Milwaukee Urban Systemic Initiative (MUSI) was launched and currently provides the most comprehensive districtwide support for the professional development of math teachers (as well as science teachers). Other professional development initiatives focusing on math teachers, although not districtwide, have also been implemented in MPS. These initiatives are listed in Appendix B.

Equity 2000 softened the blow. It helped teachers who were panicked. [Equity 2000] gave us an opportunity to understand how to respond to algebra-for-all. It brought us together. (High school math department chair)

Middle school teachers are weakest in content knowledge. We used to hold special sessions to focus on this area. We still have some sessions on math content which are incorporated into the summer institutes. High school teachers need more help in shifting their pedagogy. (Central office administrator)[30]

It started my own voyage into a more meaningful examination of my own pedagogy. For the district it opened up a painful box on beliefs about kids and what algebra was that needed to be started. (Former high school math teacher, current central office administrator)

Table 1 presents annual participation counts for Equity 2000 professional development. Teacher participation in Equity 2000 summer institutes has experienced a moderate decline since 1996-97, but that may be expected after the majority of teachers have completed this intensive training and seek only "refresher" follow-up training to maintain or learn about new skills. As a result, we see a higher volume of participation in the follow-up in-service during the later years (although as Table 1 notes teachers may have attended more than one follow-up in-service within a given year). Feedback from MPS teachers as well as documentation from MPS and external evaluation sources indicate that the majority of grade 8-10 math teachers participated in Equity 2000 professional development. During focus groups, teachers estimated that from 60 to 80 percent of math teachers in their building had participated in Equity 2000 professional development through either the summer institute, follow-up in-service, or both. The MPS Equity 2000 coordinator estimated that 85 percent of the targeted math teachers (out of a total of 88 eighth-grade teachers and 195 ninth- and tenth-grade teachers) had participated in Equity 2000 training (Henry, 1993) and that 99 percent of all middle and high school principals and 98 percent of all middle and high school guidance counselors had attended one or more Equity 2000 in-services. MDRC found supporting documentation for these estimates in the teacher survey findings from an independent evaluation conducted by the Pelavin Research Institute (1996), which also concluded that 86 percent of MPS grade 8-10 math teachers and 91 percent of guidance counselors participated in one or more of the Equity 2000 institutes or follow-up in-services (Pelavin Research Institute, 1997). On the other hand, MPS high school principals were more likely to estimate that a lower percentage (averaging from 30 to 50 percent) of math teachers in their buildings participated. As reasons for low estimates, principals cited the teachers' union agreement and high teacher turnover (including the loss of classroom teachers as a result of the creation of MUSI math and science resource teachers).[31]

Over the course of the pilot phase of Equity 2000 and MPS' transition to a demonstration site, professional development in support of this initiative has evolved in a number of ways. Training costs that once were covered primarily through the Equity 2000 grant are now funded

[30]This statement is consistent with earlier findings on Equity 2000 as reported in Mayer, 1997.

[31]Several administrators cited high teacher turnover as a problem. And because the teachers' union gives unrestricted priority for training slots to staff with the most seniority, the same teachers could attend year after year (in some cases, if they so chose) while less experienced teachers never got the chance to attend.

Table 1

Participation in Equity 2000 Professional Development

Professional Development Activity	Number of Participants by Year							
	1990-91	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98
Summer Mathematics Institutes	66	125	114	96	90	N/A	55	35
Summer Guidance Institutes	20	60	47	33	86	N/A	72	81
Follow-up Teachers' In-Service			71	N/A	159[a]	46	147	120
Principals' In-Service			80[b]	39	75[c]	81	34[d]	40[e]
Guidance/Math Networking Meetings	N/A	N/A	133	N/A	185	79	28	N/A

Sources: Henry (1993, 1994, 1995, 1996, 1997, 1998a, 1998b); Milwaukee Public Schools (1991); Richmond (1996); Talborn (1992).

Notes: [a]Most attended multiple times.
[b]Twenty-eight attended on January 29, 1992; 16 on May 22; 80 on June 17 and 18.
[c]Seventy-five attended on November 15, 1994; 44 on January 5, 1994; 27 on April 1, 1995; and 32 on June 10, 1995.
[d]Five attended on November 15, 1997; 34 on February 22, 1997; five on June 6, 1997; and 29 on June 20, 1997.
[e]Thirty-four attended in October; 40 in January (results do not include the March session).

through the reallocation of a variety of federal, state, district, and school funding sources such as the National Science Foundation, Eisenhower, Title I, and Goals 2000 and through the leveraging of foundation grants. In effect, MPS has sustained its commitment to ongoing professional development centered on Equity 2000 goals generally and, in particular, on the algebra-for-all mandate. On the implementation side, teacher training has become more focused on teacher-to-teacher efforts and is classroom-based. For instance, in the early years of Equity 2000, the summer institute trainers were primarily UWM faculty. Today, MPS teachers serve as facilitators, and more training takes place within the classroom setting inasmuch as the summer institute has been partly folded into the MPS math summer school program. Similarly, the follow-up teacher in-services have been blended into the Saturday Academy program.[32] As a cost-cutting measure, both the summer institutes and the follow-up in-service have been scaled back in length; the teacher institutes have been shortened from two weeks to one week (and from one week to 2.5 days for guidance counselors), and Equity 2000 follow-up in-services are now conducted four times a year. The target audience for Equity 2000 professional development has also shifted since the pilot phase. In support of MPS' efforts to increase mathematics achievement at the middle school level, Equity 2000 summer institutes for teachers now target training for sixth- and seventh-grade teachers in math content and implementation of a newly adopted middle school math curriculum;[33] this shift in professional development focuses more on strengthening content knowledge among middle school mathematics teachers. Also, Equity 2000 institutes for principals and follow-up in-services, which focused on middle and high school administrators during the pilot phase, have been expanded since 1997 to include elementary principals as well. Table 2 gives an example of the evolution of the Equity 2000 summer mathematics institutes for teachers. Teachers reported both pros (seeing how things work in the classroom) and cons (missing the intensive, extended training environment of the summer institutes) about changes made in the Equity 2000 professional development delivery model. However, teachers also added that, since the introduction of Equity 2000, there has been an overall increase in the number and types of math teachers' in-service opportunities within the district.

Most notably mentioned is the Milwaukee Urban Systemic Initiative (MUSI), which was introduced in 1996. MUSI is a five-year, districtwide initiative funded by the National Science Foundation (NSF) that focuses on achievement in mathematics and science by targeting K-12 curriculum reform and teacher professional development. MUSI encompasses an impressive scope of work including the development of curriculum frameworks in mathematics and science (aligned to state standards), development and refinement of the districts' proficiency assessments, and the investigation and adoption of unified curriculum programs for mathematics and science (MPS, 1997, 1998). With MUSI resources, MPS has greatly extended professional development for math teachers far beyond the scope of training offered through Equity 2000. For example, the MUSI Math/Science Resource Teachers (MSRTs) work in schools on a weekly basis as coaches and facilitators to support teacher implementation of new curricular, skills, and pedagogical approaches. MSRTs are former MPS classroom teachers, many of whom participated actively in the Equity 2000 institutes. During the 1997-98 school year, the 40-member

[32]The Saturday Academy is a student safety net program that provides mathematics enrichment instruction. A description of this program is provided later in this section.

[33]This new middle school mathematics curriculum is described in Section IV of this paper.

cadre of MSRTs worked in 81 "first-wave" MUSI schools.[34] Similar to Equity 2000, a MUSI objective for the high school mathematics curriculum is algebra-for-all. As such, MUSI is supporting teacher training and implementation of innovative algebra and integrated math curriculum programs within MPS high schools.[35] An annual MUSI/Equity 2000 in-service session is held for teachers to reinforce the connection between these two initiatives.[36]

Table 2

The Evolution of MPS' Equity 2000
Summer Mathematics Institutes for Teachers

1991-1993

- Target grade 8-10 mathematics teachers.
- Focus on pedagogy, hands-on activities; emphasize use of graphing calculators, math manipulatives.
- Use faculty from University of Wisconsin-Milwaukee as trainers.
- Conduct institute for two weeks, eight hours a day.
- Add 20 hours of follow-up in-service during school year in 1992-93.

1994-1995

- Target grade 8-10 mathematics teachers.
- Make majority of sessions classroom-based, and integrate them with the math summer school program.
- Focus on "community of learners"; teachers and students work and learn together.
- MPS teachers serve as trainers.
- Conduct institute for two weeks, five hours a day.
- Provide follow-up in-service for middle school teachers that is content-focused.

1996-Present

- Target middle school mathematics teachers; sixth- and seventh-grade teachers participate for the first time.
- Focus on content and curriculum.
- MPS teachers serve as trainers.
- Conduct institute for five days, four hours a day.
- Provide 16 hours of follow-up in-service integrated into the Saturday Academy.

Another NSF-funded activity, the Linked Learning in Mathematics Project (LLMP), also provides tremendous support for teacher training centered on the algebra curriculum and instruction. Created in 1997, LLMP is a collaboration between MPS and Marquette University whose purpose is to help middle and high school teachers implement algebra-for-all by providing training on curriculum-based reforms such as the Connected Mathematics Project (CMP), which has been adopted in all middle schools. A list of other MPS in-service initiatives that have been offered for math teachers is presented in Appendix B.

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[34]MUSI is being rolled out over a five-year period using three staggered waves of implementation. Each wave takes one to two years and focuses on implementation start-up in a cluster of schools.

[35]For details on these curriculum programs see Section V.

[36]In March 1999, NSF announced that MUSI funds would be suspended as of September 1999 pending further program review.

Also cited as instrumental to the ongoing teacher professional development in support of Equity 2000 goals and mathematics reform, generally, is the establishment and growth of MPS math teacher networks. The first MPS math teacher network (the High School Algebra Study Group) was formed in 1992. Teachers reported that the networking activity expanded their opportunities to come together for support and to share ideas and strategies that were emerging, not only from the summer institutes but also from their own classrooms. These early network participants described their experiences:

> *A group of teachers [from different schools] started meeting. It was a gripe session at first. We realized we weren't alone and that our school wasn't the only one feeling frustrated. We started sharing things — ideas that we had tried with our kids. We learned from each other.*

> *The networks came about as a result of teachers feeling they needed support and ways to deal with the district mandate [of algebra-for-all] because of the difficulty getting more kids involved with algebra. It was a chance for teachers to talk with each other, and work with each other.*

Since 1992, other math networks have been established, such as the Middle School Algebra Network, the Geometry Network, the Advanced Math Network, and the Pittsburgh Urban Mathematics Project (PUMP) Network. Network members meet two to three times a month, guided by UWM faculty who work with teachers to give the networks a more formal structure. All but one of the networks are classified as semester or full-year UWM courses through which participating teachers earn undergraduate college credits. Ideas that emerge from the networks are helping to provide classroom tools and to shape policy for the district. For example, early work from the Algebra and Geometry networks produced model exams that were distributed to teachers throughout the district for use in helping to define the content of those courses. Similarly, when the High School Algebra Study Group merged with the Middle School Algebra Network to form the Algebraic Reasoning course in the fall of 1997,[37] participants were given responsibility for designing five exemplar performance tasks for the district's eighth-grade proficiencies.[38] Participation in the network courses is open to any teacher, and an average of 15 to 20 teachers enroll annually in each course. For participating in the networks, teachers receive a stipend paid through federal Eisenhower funds.[39] MUSI resources also serve to support teacher networking activity.

Retooling Teachers' Classroom Practice

Principals and teachers reported that math classroom instruction had changed to some degree as a result of Equity 2000 professional development. Changes cited include increased use of calculators (including graphing calculators), manipulatives, and technology and less reliance on textbooks. While it was reported that whole-class, lecture-style instruction is still dominant,

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[37]The High School Algebra Study Group was reestablished in the fall of 1998 to provide a forum for dialogue focused on high school algebra curricula and instruction.

[38]The MPS eighth-grade math proficiencies are described in Section V of this paper.

[39]Dwight D. Eisenhower professional development grants are U.S. Department of Education grants, issued under Title II of the Elementary and Secondary Education Act (ESEA).

teachers felt they (and their colleagues) were integrating more student work with calculators and more project- and group-based learning activities as a result of Equity 2000. Principals and teachers also reported that the synergy between Equity 2000 and other district reforms — in particular MUSI and School-to-Work — created a climate of support for teachers to learn about, experiment with, and incorporate alternative approaches to instruction. Teachers, especially, talked not only about changes in classroom practice but also about changes in collegial exchange among teachers. The following comments reflect principals' and teachers' responses in this regard:

> *We got a lot more calculators, graphic and scientific. A lot more teachers using them. More group instruction and not as much lecture oriented. . . . We're trying to get to an application-oriented model instead of skills-oriented. . . . [Equity] had a significant impact on me in terms of how I looked at teaching and what I was trying to do in the classroom and I am no where near the same teacher I was ten years ago.* (Teacher focus group comments)

> *Equity 2000 gave new ideas to teachers, provided resources, especially teachers as a resource. It made me use calculators more in class. . . . When block scheduling was introduced to the school, our [math] department was a step ahead because of Equity. It gave us a variety of approaches to use with students.* (Teacher focus group comments)

> *[Equity 2000] made me use more calculators, more group work. . . . Prior to Equity, people [teachers] were isolated. [Now] people work together to solve problems. . . . School-to-Work helped because math's relationship with jobs is apparent. Math background expands students' career choices. . . . Ninety percent [of teachers] have changed strategies; 5 percent waffling, waiting for more positive results; and 5 percent refuse to change anything.* (Teacher focus group comments)

> *I'd say no more than one-third of my teachers participated in Equity training. I see that one-third being much more successful. More of their students are passing, all other things considered equal. [Discipline] referrals are low in their classroom, connections are being made with students, and they're using cooperative learning, manipulatives, and technology more. Staff development is the key.* (High school principal)

These statements are supported by the MPS Equity 2000 audit reports, which for high schools were generated annually from 1994 to 1997; middle school audits were conducted for two years starting in 1995.[40] The audits focused on implementation — specifically, how Equity 2000 strategies for math classroom instruction and guidance were being implemented in schools. In reviewing Equity 2000 high school audit reports conducted in 1994 and 1997, it appears that teaching practices which are encouraged by Equity 2000 have become more prevalent across high school Algebra I classes. Table 3 presents a point-in-time comparison of Equity 2000 audit

[40]The Equity 2000 audit reports were managed by independent consultants who designed the audit data collection process, supervised the audit teams, and produced school- and district-level audit reports. Each audit team was composed of a teacher, principal, and guidance counselor. Equity 2000 audits were not funded during the 1997-98 school year due to funding constraints.

Table 3

Practices Encouraged by Equity 2000 in MPS High Schools*

School Name	Observed/Reported Teaching Practices in Algebra I									
	Calculators		Group Work		Manipulatives		Computers		Real-World Application	
	1994	1997	1994	1997	1994	1997	1994	1997	1994	1997
Bay View	Yes	Frequent	Yes	Seldom	No	Seldom	No	Seldom	No	Frequent
Custer	Yes	Frequent	Yes	Regular	Yes	Seldom	Yes	Regular	No	Frequent
Hamilton	Yes	Frequent	No	Frequent	No	Seldom	No	Seldom	No	Regular
Juneau	Yes	Frequent	No	Regular	No	Seldom	Yes	Seldom	No	Regular
King	No	Regular	Yes	Regular	Yes	Seldom	No	Seldom	Yes	Regular
Madison	Yes	Frequent	No	Regular	No	Regular	No	Seldom	No	Regular
Marshall	Yes	Frequent	No	Regular	No	Seldom	Yes	Seldom	No	Frequent
Milwaukee High School of the Arts	Yes	Frequent	Yes	Regular	Yes	Seldom	No	Seldom	No	Regular
Milwaukee Trade & Technical High School	No	Frequent	Yes	Seldom	No	Seldom	No	Seldom	No	Frequent
North Division	Yes	Frequent	Yes	Frequent	Yes	Seldom	Yes	Frequent	No	Regular
Pulaski	No	Frequent	No	Regular	No	Regular	No	Seldom	No	Regular
Riverside	Yes	Regular	Yes	Regular	Yes	Seldom	Yes	Seldom	No	Regular
South Division	Yes	Frequent	Yes	Frequent	Yes	Frequent	No	Regular	Yes	Regular
Vincent	Yes	Frequent	No	Regular	No	Regular	No	Seldom	No	Frequent
Washington	Yes	Frequent	No	Regular	Yes	Seldom	Yes	Seldom	Yes	Regular

Source: Brandl (1994, 1997).

Notes: *Does not include MPS high schools established since the 1993-94 school year.

Seldom: Used less than three times a month by the majority of teachers.

Regular: Used one or two times a week by the majority of teachers.

Frequent: Used three to five times a week by the majority of teachers.

findings on teaching practices used for Algebra I instruction.[41] These findings indicate that in 1994 the use of calculators was observed at most schools, and it remains a common technique among Algebra I teachers. The use of group work or cooperative learning was observed in a little more than half the high schools in 1994. By 1997, up to 90 percent of MPS high schools had a majority of Algebra I teachers who reported that they regularly used this teaching technique. Over this same time period, the use of manipulatives and computers in algebra classes appears to have also increased — from being observed in less than half the schools to reported use in all high schools. However, these increases could be considered modest, since use was generally reported to be seldom.[42] Probably the most dramatic change in teaching practices for Algebra I has been the integration of real-world applications. During the first year of the algebra-for-all policy, only three high schools were observed using this technique in Algebra I classes; in 1997, algebra teachers in all the high schools reported that they either frequently or regularly integrated real-world applications into their instruction.

Student Safety Net Supports

A key component of Equity 2000 is the provision of student safety net supports. Safety nets both (1) foster students' motivation and enjoyment for learning mathematics through enrichment programs and (2) provide math tutoring and support or make-up classes for students who need extra help. As reported earlier in this paper, technical assistance provided by the Equity 2000 National Office involved identifying and enabling districts to implement established programs (such as the Saturday Academy) and strategies (like Algebra Readiness classes) for enhancing student academic achievement. In Milwaukee, Equity 2000 safety net activities include city-wide supports and local supports. *City-wide supports* are centrally coordinated by the district and include such activities as the Saturday Academies (for students and parents), tutoring services through the Math Buddies program, and the math summer school program. *Local supports* are school-based safety nets such as tutoring services before, during, and after school; algebra support classes; and midyear reprogramming options. Participation data presented in Table 4 show the variety and use of safety nets created through Equity 2000 since the initiative has been in place.

In total, the safety net support structures that MPS has created to enhance students' mathematics achievement have the potential to serve a substantial amount of students. However, as the information presented below indicates, students' motivation and incentives to take advantage of such opportunities must be addressed if the benefits of these activities are to outweigh their costs. MDRC was not able to obtain documented information on the impact of safety net support activities — that is, whether students who participated in safety nets actually performed better than a similar group of students who did not.[43] If data are not available, the district's in-

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[41]In 1994, the high school audit findings primarily reflected *observed* teaching practices for Algebra I instruction. In 1997, the findings primarily reflected *reported* teaching practices of Algebra I teachers. Comparisons between 1994 and 1997 should take these differences into consideration.

[42]As will be discussed later in the paper, computer use in the instruction of algebra increased dramatically during the 1997-98 school year, when several schools adopted a technology-based algebra curriculum.

[43]An analysis of this type is currently being undertaken in Prince George's County, Maryland, which is another Equity 2000 district. There, Dr. Paul Gammill is analyzing student participation data from the Equity 2000 Saturday Academy program and participants' subsequent enrollment and passing rates in Algebra I and Geometry (in com-

(continued)

vestment in such activities warrants a closer look: For which students, and in what ways, are these safety nets successful in increasing achievement (especially among students who need the most help) in Algebra I and other measures of high standards in mathematics?

Table 4

Equity 2000 Student Safety Nets

Safety Net Activity	Participation Levels by Year						
	1991-92	1992-93	1993-94	1994-95	1995-96	1996-97	1997-98
Saturday Academy		80	368	596	554	414	448
Parent Academy			N/A	27	N/A	11	20
Study Tables					—	49	65
Math Summer School[a]		360	563	539	N/A	287	397[b]

Sources: Henry (1993, 1994, 1995, 1996, 1997, 1998a, 1998b); Milwaukee Public Schools (1998a); Richmond (1996).

Note: [a]Reflects only enrollments in Algebra Readiness and Algebra I make-up classes.
[b]Reflects only enrollment in Algebra I make-up classes

Equity 2000 Saturday Academy. MPS launched its Saturday Academy program in spring 1993 to provide academic enrichment in mathematics and expose students to college. In 1997-98, science enrichment was added to the program (in support of MUSI). The math teacher who coordinates the Saturday Academy program explained that the goal is "to help kids see that math is more than just a dry subject . . . to show them it has applications to the real world." The coordinator described the Saturday Academy learning environment in this way: "We do a lot with computers, a lot of hands-on. Kids work in groups a lot. Nobody stands up and lectures. It's discovery learning." Parent involvement is encouraged throughout the six-week academy program. On the first and last sessions of the program, parents are invited to join their children in academy activities and to learn about the goals of the algebra-for-all policy. Special Parent Academy sessions are conducted each spring to give parents suggestions about how they can help their children do better in school and prepare for college. In addition, parents are invited to join a field trip to the Historically Black Colleges and Universities (HBCU) Fair, which is held annually in Chicago.

The Saturday Academy operates through a partnership between MPS and the UWM. Offered twice a year (each fall and spring), the six-week academy program is housed on the UWM campus. The location helps to reinforce the guidance component of the academy, which focuses on developing students' goal-setting skills and their expectations about going to college.[44] How-

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Academy program and participants' subsequent enrollment and passing rates in Algebra I and Geometry (in comparison with students who had similar characteristics but did not participate in the Saturday Academy).

[44]In addition to the Saturday Academy, the MPS offers several programs which exposed students to college campus-based learning activities, mostly coordinated through the Office of Guidance and Career Education.

ever, the UWM campus is located on the north side of Milwaukee, and the coordinator reported that students who live in other parts of the city rarely attended — even though the Saturday Academy offered free city bus passes to commute to the program.

During the pilot phase of MPS' Equity 2000 initiative, the Saturday Academy targeted students in grades 8-10 who were referred by guidance counselors. In 1996, however, participation was opened to any middle school or high school student who wanted to attend; consequently, the majority of participants are now in grades 6-8. Most high school students who participate in the academy do so primarily through the Study Tables program (added in the spring of 1996), which provides tutoring to help students prepare for the high school math proficiency exam. Students are made aware of the program through flyers that are distributed by guidance counselors (and learning coordinators at the middle school level). The Saturday Academy is staffed jointly by MPS math and science teachers and guidance counselors and by UWM faculty and college student mentors. On average, about 200 middle and high school students participate in each academy.

Math Summer School Programs. The math summer school programs seek to provide extra support for low-performing students and, in Milwaukee, began with the Algebra Readiness course, which was first offered in 1993 to prepare incoming high school freshman for the Algebra I requirement.[45] The math summer school program expanded the following year to include Algebra I make-up classes for students who had failed this course during the school year. In 1995, a Geometry make-up course was introduced, and, in 1996, math proficiency classes were added for incoming seniors who had failed this graduation-requirement exam during their junior year. Student participation in the math summer school program is voluntary, and the district does not report figures on the percentage of high school students who participate in these programs. Recently, however, MPS did issue a report on passing rates among students who are enrolled in summer school courses. Data from the 1998 math summer school program show that 183 students enrolled in Algebra Semester I make-up classes (141 passed), and 214 enrolled in Algebra Semester II make-up classes (161 passed).[46] These figures suggest that the majority of students who enroll in the Algebra I make-up classes complete the course successfully. More in depth analyses would be necessary, however, to reliably assess the impact of this safety net activity.

Since 1995, the math summer school program has been partly integrated with the Equity 2000 math teacher institute to reinforce the theme "community of learners," whereby teachers and students work together to apply instructional innovations for the teaching and learning of mathematics. One summer school teacher felt that this activity has helped keep students from dropping out of the summer school program because the institute teachers provide more opportunities for one-on-one attention and smaller-group instruction that low-performing students crave and need in order to be successful. Another teacher thought that integrating the math teacher institute disrupted the math summer school program.

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[45]The math summer school program was MPS' only summer school offering until 1998, when summer school was reinstated in all discipline areas.

[46]These totals represent a mixture of ninth-grade and upper-grade students who failed one or both semesters of Algebra I during the school year.

Tutoring Services. The district allocates $200,000 annually to support site-based mathematics tutoring programs at the middle and high school levels. Tutoring services may be offered before, during, or after school (or any combination thereof), depending on the site. However, teachers report that too few students take advantage of the tutoring services offered at their schools. One Algebra I teacher who lets his students know that he is available to give them extra time with tutoring adds that "only two people have taken advantage of the offer." In addition, a program called Math Buddies provides tutors for high school juniors and seniors who want or need help preparing for the mathematics proficiency exam. Started in 1995, Math Buddies are volunteers from MPS staff, local employers, and the community at large who tutor students for this purpose.

Midyear Reprogramming and Algebra Support Classes. Equity 2000 encourages districts to structure their Algebra I courses using a *semesterization model* whereby "these courses have been divided into two parts, each a semester (half-year) long" (Choike, 1996, p. 25). This model is recommended because it allows students who fail the first semester of Algebra I to repeat this section of the course during the second semester. Without semesterization, a student could spend an entire year taking Algebra I before receiving an official grade — which, for students who fail, can be highly frustrating and discouraging. MPS high schools that use the semesterization model may elect to "reprogram" Algebra I ninth graders based on midyear grades. Algebra I reprogramming was quite popular during the pilot phase of Equity 2000, and all but one of high the schools continue to use this strategy (teachers at a second high school may drop it in the 1998-99 school year because of a shortage of math teachers). Another strategy that some schools offer is the algebra support class. Algebra support classes (which are offered mostly as an elective) allow students who need help to "double up" with two periods of math. However, teachers report that student enrollment in these courses is generally low because of competing demands with other graduation-requirement courses.

Block Scheduling. Several high schools in Milwaukee have adopted *block scheduling* to extend the time for academic instruction. Schools that revise their daily schedule in this way generally extend the traditional 45-minute instructional period per class to an 80-90 minute "block," which provides more uninterrupted time for teaching. In other words, the number of class periods is reduced, while the time of each class period is lengthened. Although no one reported that block scheduling was adopted specifically as a safety net for students in Algebra I, several teachers commented that the additional time allocated through block scheduling has allowed them to pace their instruction more effectively and to give more attention to students who need extra help. On the other hand, teachers also reported that block scheduling made it more difficult to make midyear reprogramming assignments because this type of schedule does not easily accommodate add-on classes. Nearly half the schools represented by our focus group sample used block scheduling.

The Role of Guidance in Promoting High Expectations for Students

Equity 2000 is the first (and perhaps the only) standards-based initiative that focuses on the role of guidance counselors in supporting education reform. In this respect, Equity 2000 conveys a unique perspective of what it takes to effect high standards in student achievement by tapping into and expanding the resources of guidance staff in support of the initiative's long-term objective — to increase the college enrollment of low-income and minority students. To accomplish this goal, Equity 2000 integrally involves guidance services to increase the likelihood that

all students are encouraged to enroll in rigorous coursework and to consider postsecondary avenues with the same high level of expectations that has traditionally been predetermined (primarily based on prior grades and test scores) for a select, college-bound segment of the student population. The guidance component of Equity 2000 specifically addresses the mission of increasing low-income and minority students' exposure to college campus learning experiences during the middle and high school years and providing them successful preparation for and transition into college.[47]

The Equity 2000 guidance institutes serve as the key vehicle for reinforcing precollege planning, identifying opportunities for students' college campus exposure, enabling counselors' awareness and understanding of algebra as a gatekeeper to college enrollment, and reinforcing the role of guidance services in promoting a high-expectations learning environment. According to the MPS director of guidance, these institutes had profound effects on the shape and direction of guidance services in Milwaukee:

> *The first thing I did with counselors was to create a revised mission statement of our role which is to provide each student with the resources necessary to be successful after high school. Now we see guidance responsibilities as encompassing three areas: personal/social, educational planning, and career development. We give far more attention to educational and career planning than we did before. I'd say our time in this area has increased from 50 percent to 75 percent since Equity 2000. Scheduling and testing which used to be the focus of most of our time is now about 15 percent. The personal and social counseling is about 10 percent of our time, which is a decrease.*

Figure 1 presents a narrative graphic (developed by the MPS Director of Guidance and Career Education) of changes in the district's guidance approach since adopting Equity 2000. This approach advocates that guidance counselors begin working early with students and parents to discuss and plan for postsecondary options. The Equity 2000 guidance model also stresses collaboration between guidance staff and teachers and parents to help students understand the importance of Algebra and advanced-placement coursework in preparing for college. Equity 2000-sponsored network meetings for guidance counselors and math teachers are credited with fostering exchange on issues affecting student placement, classroom lesson planning, and resources available through the guidance office. One middle school counselor reported that she is often invited into classrooms to present information on postsecondary degrees and careers that correlate with particular academic subjects. Another counselor said that teachers in her school schedule their entire class to come to the guidance career center as part of a lesson unit. Other comments from guidance counselors (and teachers) in this regard include:

> *Equity shifted the focus of guidance beyond seniors and more towards postsecondary preparation of earlier students.* (High school guidance counselor)

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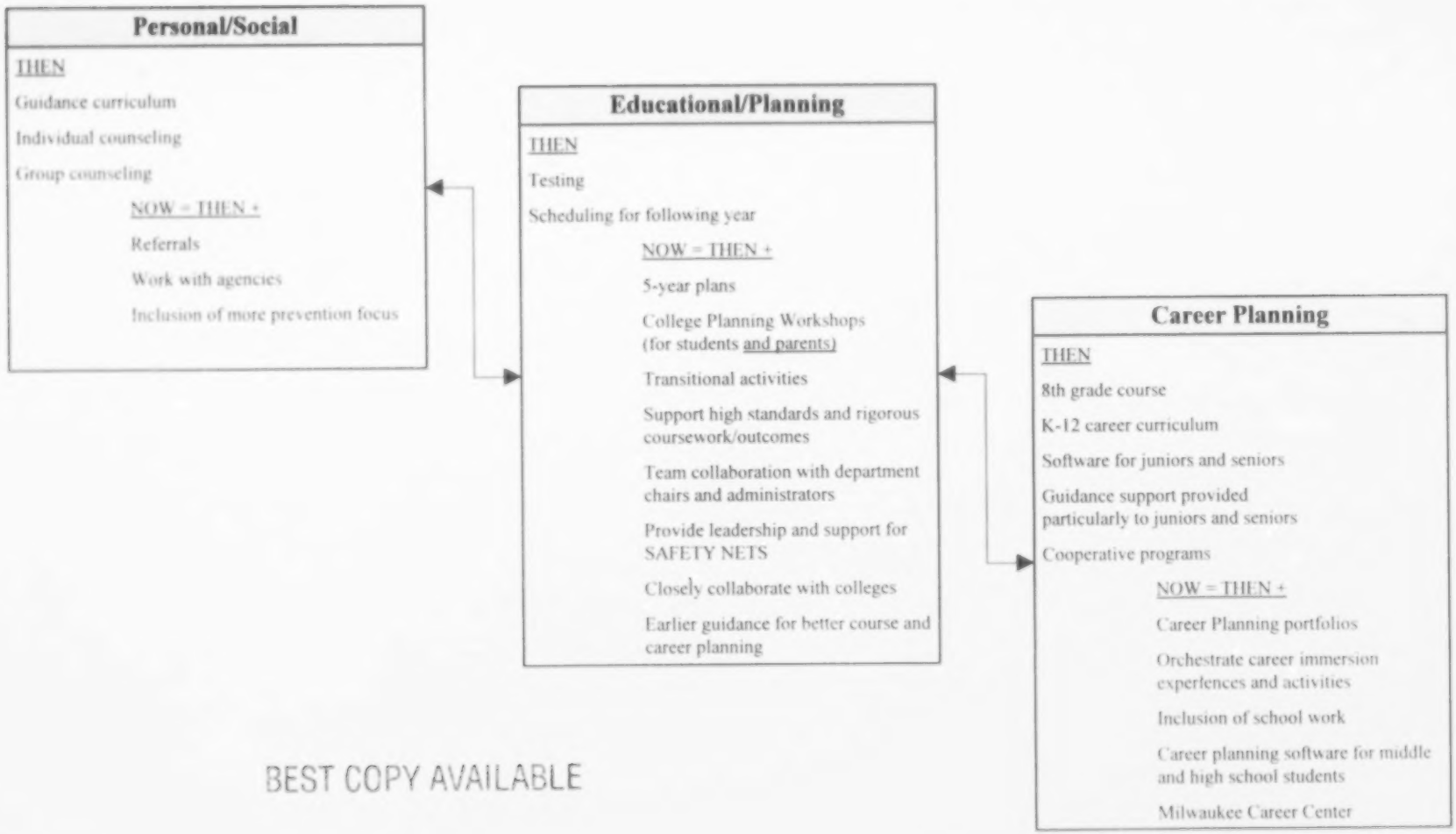
[47]As previously discussed, the Saturday Academy is one of several programs in place in Milwaukee to meet this objective. Another program that plays a major role in promoting college exposure for low-income and minority students is the Minority Precollege Scholarship Program, which is funded by the Wisconsin Department of Public Instruction. More than 1,000 Milwaukee students earn scholarships through this state-funded program each year; in 1996-97, a total of 1,814 students participated.

Figure 1

Then and Now: MPS and Equity 2000 Developmental Guidance Model



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Source: Dr. Lynn Krebs, Director, MPS Office of Guidance and Career Education (1997)

Guidance people are more proactive. . . . Before guidance counselors stayed in the office, but now the philosophy of the school is to support each other. (Middle school counselor)

Equity taught me how guidance had to work in leveraging college through the gatekeeping role of algebra. Counselors were becoming partners with us [teachers] to get kids to see the importance of math. We were not allies in that regard before. (High school math teacher)

Counselors now are not as removed from classrooms. Counselors discuss with teachers who should be assigned to algebra support classes. (High school teacher)

Middle and high school counselors also indicated that there has been increased involvement of guidance staff in providing students with information about the application of math and other academic areas in the workplace through the use of career centers. (Counselors seemed to attribute this change to School-to-Work more than to Equity 2000, but they felt that the goals of these two initiatives meshed nicely in this regard.) The career centers house information about colleges and career options. Students may visit the centers individually, although in some cases teachers schedule a visit to the center as a class assignment. Depending on available space, a school's career center may be housed within the guidance office, in the media center, or as a stand-alone office. In one school, teachers' support for a center was so strong that they gave up their lounge to create it, but the center was later moved into the cafeteria to make it more conveniently accessible to students. The MPS director of guidance reported, "We have career resource centers in all middle and high schools this year. Before Equity 2000, only two high schools and none of the middle schools had career centers."

IV. Barriers to Student Achievement in Mathematics

For several years now, the vision statement for Milwaukee Public Schools (MPS) has been, "Milwaukee Public Schools will become the first urban center in the nation to have all students performing at high levels." The push for high standards in mathematics has been supported through a number of MPS education reform initiatives, which have worked in synergistic fashion to promote the establishment of new high school graduation requirements as well as math proficiency standards and assessments for middle and high school students, the development of K-12 curriculum frameworks, the unified adoption of mathematics curriculum programs, and teacher professional development.[48] Despite MPS' focus on raising academic standards in mathematics, however, students in the district perform well below state and national norms on standardized tests. According to the *MPS 1996-97 Accountability Report* (Milwaukee Public Schools, 1997b, p. 7), "Across all grade levels, mathematics appears to be the lowest achieving component for all tested MPS students." This report also shows, however, a three-year increase in the percentage of students passing the high school mathematics proficiency exam on the first administration (done in the spring of the junior year) — an increase MPS officials attributed, in part, to Equity 2000, given that the increase coincided with the first cohort of ninth graders that was affected by the algebra-for-all mandate (Adbul-Alim, 1997). Nonetheless, when nearly half the ninth graders enrolled in Algebra I (47 percent) do not pass this course by the end of the year, there is great concern among teachers and other MPS educators that the benefits of this Equity 2000 objective are curtailed.

At a time when private-school vouchers and the threat of state takeover are constant reminders of the pressures that large urban districts face in meeting student performance goals, MPS understands well that setting standards without the guidance and support needed for all students to achieve them is a failed cause. This section of the paper presents MPS educators' perceptions about key challenges to increasing the rate of Algebra I completion by the end of ninth grade. Three factors were commonly cited in this regard: (1) students' low attendance and poor preparation in math, (2) large class size and its impact on teachers' ability to meet the diverse learning needs of a heterogeneous student population, and (3) the limitations on building teacher capacity.

Student Attendance and Preparation in Mathematics

Persisting failure rates in ninth-grade Algebra I were frequently attributed to student's low attendance and poor preparation in math. It did not take long for MPS educators to establish the link between low attendance and poor performance in algebra, as the following excerpt from one former MPS superintendent's February 1995 status report on Equity 2000 states:

> *We know that when students attend class regularly, four out of five pass algebra. However, too many of our students are not in school regularly and, thus, are not passing algebra. We know that with care, motivation and support, many more of our students can be successful.* (Jasna, 1995, p. 3)

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[48] An overview of these initiatives is presented in Appendix A.

More than three years after this report was issued, teachers indicate that low attendance continues to be a critical barrier to student success in algebra. Their comments in this regard include:

> *Our teachers are good enough that if [students] come, they can learn — even if they've had poor preparation in middle school. . . . People here are discouraged when 25 percent of your class is out everyday. . . . [The] biggest problem that I find is attendance. . . . Attendance is a vicious problem right now. Kids shoot themselves in the foot with it.*

Teachers estimate an average daily absentee rate of 25 percent, which is consistent with the district's calculation on attendance. Efforts to raise student attendance through incentives and increased communications with the home have yet to yield significant gains in this area. Several teachers also felt that there was no accountability system in place at the student or parent level to deter high absenteeism. "You can be absent with impunity," one teacher complained. However, increased attention is being focused on this prevailing problem. Student attendance has been identified as a key priority for the district, and MPS has set a districtwide goal of 91 percent attendance by the year 2000. Both guidance counselors and teachers report that factors outside of school sometimes prohibit students from attending class regularly and that there is a need for alternative designs in the length of the school day and the school year to accommodate students who fall into this category.

Teachers generally reported that they support the philosophy of algebra-for-all and understood the gatekeeping role that algebra plays in increasing the likelihood of college entrance. However, teachers also felt that too many of their students came to the ninth grade lacking the basic math skills to grasp algebraic concepts, making effective implementation of the policy problematic. For a few teachers, "lack of preparation" referred to students' coming to class without required materials (such as calculators, which students are required to purchase) or without completing homework assignments, studying for tests, etc. But most comments about preparation referred to students' prior knowledge and understanding of math concepts:

> *I think most of the people who have been involved in Equity [2000], we do believe that students need algebra and that all students should have an algebra class. However, not all of them are prepared and ready to take algebra.*

> *I had no problem with it [the algebra-for-all mandate]. . . . My concern has become that too many [students] come without preparation. . . . I would like to see algebra and geometry required, but I don't know if [ninth graders] need to start there.*

> *[The] kids are not prepared. Even the basic things such as 2 x 5 or how many minutes in an hour.*

As a result, teachers report that they have been forced to change the pace and content of their Algebra I classrooms. In fact, with the enrollment of all ninth-grade students in Algebra I (many of whom are perceived not to have sufficient background in mathematics), teachers feel that Equity 2000 may have had the unanticipated result of "watering down the curriculum":

[You] have to start back so far because they don't have the background. Also students get very bored when they don't know what you're talking about. I have to break down the lesson three times, but then you can't cover as much.

Algebra is mostly pre-algebra now. . . . We didn't solve the algebra problem — we threw away algebra and made pre-algebra.

You do a lot of re-teaching. My [students'] grades are better, but it doesn't cover the entire curriculum. After a full year, we've only got as far as what I used to teach in the first semester [of Algebra I].

We used to have a one-year algebra course. We moved to block scheduling two years ago. That put us on a three-trimester schedule, 12 weeks per trimester. We tried Algebra I as a trimester course, squeezing a whole year into 12 weeks. The kids failed miserably. Now all incoming ninth graders go into a two-trimester Algebra class. The first trimester is a review, like pre-algebra. The second trimester is algebra.

When kids aren't in school there is a tendency [for them] to be a grade lower than if there were there everyday. So if they are not there, they are not getting the skills [and] if they are not getting the skills, they can't do well so you feel that sometimes you have to water down the curriculum.

The perceived lack of student preparation in math was attributed to two factors, the middle school math curriculum and poor math content knowledge of middle school teachers. Here are some representative comments:

They [the district] have to provide teaching for teachers. There's not much [math] expertise left in the middle school.

We need more teacher training in the middle schools for mathematics because there's just too many non-math teachers in middle school. Some wonderful teachers, but. . . .

Some [middle] schools don't even have math teachers to teach math because they [middle school teachers] have the 1-8 degree. . . . They may concentrate on what they feel most comfortable with and may not even try to do any of the algebra if they don't feel comfortable with it and those kids will lose out when they come to the high school. And some kids will go to a middle school where they had a teacher who was really good at it and really emphasized it a lot.

However, there are MPS educators who contend that lack of student preparation *is not* the most critical factor in current achievement trends. These individuals perceive barriers to achievement as more a reflection of teachers' low expectations or teachers' inability to employ instructional approaches that better engage students in the learning process. As one teacher argued, "I don't believe that students come to class lacking basic skills. Asking them what they know is not enough for them to tell you." This teacher believes that teachers need to be more creative in how they approach algebra instruction and in how they engage students to get them to express what

they know. For instance, this particular teacher is using an algebra curriculum program called the Pittsburgh Urban Mathematics Project (PUMP).[49] This teacher said PUMP provided a different way of teaching algebra:

> *Before [students] had to know the rules to do the work. . . . In PUMP the first thing is to get a feel for what students know. . . . All problems are done with words, situations are more real, more accessible. I can have a discussion with students. . . . I realized that students do come to class with lots of knowledge.*

There was general consensus, however, that high-absentee students were likely to have poor preparation in math and represented the bulk of "repeaters" in Algebra I. Repeaters are students who fail Algebra I during their ninth-grade year, do not make it up during summer school, and have to take the course over in tenth grade (or again and again, if they continue to fail). Teachers' estimates of the proportion of repeater students ran quite high, from 30 to 40 percent of their Algebra I enrollment. In some schools, repeaters are assigned to the same Algebra I classes with first-time ninth graders, although there seems to be a trend among schools to try to develop a separate Algebra I course for repeaters. Algebra I classes for repeaters are usually revamped to avoid duplicating the ninth-grade course. As one teacher said, "We have a class that is something like a support group for repeaters. They tend to be absent a lot, so we know we need to spend a lot of time with them." Teachers felt that the repeater students had the greatest need for extra support and yet were most likely to slip through the cracks. One teacher cited that the marking-period reports on Algebra I passing rates that were issued by the MPS Office of Research and Assessment included information only for ninth graders; data on tenth- or eleventh-grade repeaters were not tallied.[50] Another teacher reported, "I had one student who took [Algebra I] six times. I was number six, [and the student] still didn't get through it!" The 1996 MPS Equity 2000 audit report also concluded that monitoring of repeater students required "substantial attention." The audit report's author writes: "it's very hard within the current [MPS] data system to track what is happening to repeaters. I've tried to do it, but it's hard to disentangle these data. My fear is that repeaters just get caught in this cycle, which could be very discouraging for them, but I haven't been able to confirm what really happens to them. . . . I believe the problem to be staggering." Because the size of the repeater group was considered significant among teachers, it would be worthy of study to identify and review the types of reassignment and support strategies that are used with these students to determine how best to raise their math achievement.

Large Class Size and Meeting the Diverse Learning Needs of Students

As stated earlier, effective the 1993-94 school year, MPS eliminated the general math curriculum in the high schools by making Algebra I a requirement for all ninth graders who had not previously passed this course (or were excused from it based on their individual education plan). The goal of the policy was to establish high expectations for all students by setting a standard of rigor for the ninth-grade math curriculum. Recalling the prevalence of low-level math

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[49] PUMP is discussed further in the next section.

[50] The Algebra I semester reports were not issued in 1997-98 because many high schools no longer operate on a six-week semester schedule. With the advent of block scheduling, the variety of semester grading systems prohibited the production of marking-period reports.

courses in her own school before Equity 2000, one teacher reported that "out of nine [ninth-grade math] courses only one was algebra." One central office administrator attributed this effect to Equity 2000:

> *Equity has been successful in de-tracking. There is no more "applied math or technical math courses." All ninth graders enroll in a full-year Algebra I course. . . . All schools are* supposed *to have one standard of Algebra [I] course-work, but I'm not sure what is actually going on in the classrooms.*

However, one high school counselor explained that (at his school) incoming ninth-grade students are assigned to different sections of Algebra I that are targeted to serve students of average academic performance, students considered college-bound or gifted, or students who have had trouble with math. According to this counselor, such assignments are based on "what we see on their [middle school] report cards" and their attendance, and he concludes, "It may look like a sort of tracking, and it probably is." Regarding this issue, another school administrator had this to say:

> *We have to offer options. If students fail after one semester, the student is reprogrammed to begin the course again. I would guess we have five or six reprogrammed classes . . . out of a class of 650 freshman. We offer a regular geometry and technical geometry which includes pre-algebra concepts. We have a program for the academically talented where students move on to higher levels of math.*

And yet another administrator explains it this way:

> *Equity 2000 is about equalizing exposure and opportunity. Equality is downplayed. We're not trying to give all students the exact same thing. It took us a long time to realize the difference.*

A comparative review of 1994 and 1997 Equity 2000 audit reports[51] indicates that MPS high schools do not offer math course options lower than Algebra I, and so the Equity 2000 objective of eliminating low-level math courses *appears* to have been met in MPS.[52] When the Equity 2000 audits were first conducted in 1993-94, some schools offered a separate Chapter I Algebra course, but in 1996-97, no such course was listed. The audit reports did show, however, that most high schools continue to offer at least two levels of Algebra I — one for regular students and one for gifted and talented students (often referred to as Honors, International Baccalaureate [IB], or Program for the Academically Talented [PAT]). In 1993-94, out of 15 high schools, 11 offered a separate Algebra I course for gifted and talented students. In 1996-97, nine high schools were reported to have such a course, and in one high school, separate bilingual and

[51]The Equity 2000 audits were not conducted earlier than the 1993-94 school year; thus a pre-Equity 2000 comparison of course offerings was not available.

[52]We present this statement tentatively because our preliminary review did not include an assessment of the content or rigor of MPS Algebra I courses.

ESL Algebra I courses were offered as well. So, despite the elimination of low-level mathematics courses, some residual tracking may remain.[53]

Guidance counselors and teachers conveyed that the overwhelming majority of ninth graders were placed in regular Algebra I classes and that these classes did, in fact, represent a broad range of math skill levels. However, the challenge of meeting the needs of all students in a diverse, heterogeneous learning environment was a frequently mentioned concern. Teachers cited tensions in their own classroom practice between providing stimulating and challenging instruction for students who are ready to grasp new skills and providing support and extra time that are often needed for students who are struggling.

> *Most of us would like to . . . be allowed some discretion in our ninth-grade algebra, that is, running a two-year algebra class or something so that we can move at a slower pace.*
>
> *You have so many different ability groups in a classroom. To some extent it works great, so then you can have some of the kids mentor the kids that have lesser skills but then at the same time you want to bring up the higher-level kids and sometimes you don't always get to do that and then they are the ones who are losing out too.*
>
> *Exceptional education students would do the math work with the algebra tiles and actually understand it, especially positive and negative numbers. Much more than in the past. Some students rebelled tremendously against using algebra tiles because . . . [they] were on the calculus train in a regular algebra class . . . when you tried to use the algebra tiles, you would lose those type of students.*
>
> I *think everyone should have the opportunity, but you need to have grouping. Why make kids hate math because they're failing. It frustrates them and they grow fearful of it — by then, we've lost the equity already.*
>
> *You have to be up on multiple intelligences. I always take workshops, belong to professional organizations.*

These sentiments about curriculum options may yield opportunities for research on the issues of ability grouping and tracking. In an NCTM publication entitled *Algebra for Everyone* (1990), math educator Richard Lodholz states, "We can, in fact, hold to some sorting of students by their talents, values, and interests if we change the emphasis in content and organize the pacing and instruction" to ensure that all students "would be capable of understanding algebraic concepts at least by grade 10" (p. 25). In traditional ability grouping practices in mathematics, curriculum options exclude certain students from *ever* reaching the desired level of algebraic understanding.

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[53]MDRC did not attempt to examine data on the placement and/or achievement of students in the gifted and talented Algebra I classes to see whether ethnic and gender representations were in proportion to the composition of students in the regular classes.

Teachers also raised the issue of "disconnect" between the Equity 2000 training environment and the daily realities of the classroom. Teachers report that, although they enjoy learning about and using innovative techniques to work with students during the summer institutes and Saturday Academy training classes, the challenges faced in the regular school environment make application much more difficult. A concern, in particular, was the issue of class size. Teachers reported that the average Algebra I class has 30 to 35 students. According to one teacher, "[In the] last six years in our building, algebra has increased in class size by 13 students per class," to which another teacher added, "And they're getting larger. You cannot give [students] the individualized instruction." These class-size estimates are in sharp contrast to the 5:1 student-to-teacher ratio that teachers experience at Equity 2000 training venues that are classroom-based, such as the math summer school program and the Saturday Academy. Consider these comments by two teachers (one who teaches for the Saturday Academy and one who teaches the math summer school Algebra Readiness class):

> *The kids come to Saturday Academy and think math is really fun and hands-on. Then they go back to their schools and do 20 problems in the textbook. It is hoped [that teachers] will take some ideas back to the classroom. [But there's] a difference between teaching 30 kids by yourself and having 30 kids and five teachers in the classroom with you. You can't get around to every kid if you're by yourself.*

> *I have eighth graders this summer who'll be going into ninth grade next year in an algebra readiness class, and one girl sits there with her multiplication chart from 0 to 12 both ways, and she tried to do division the same way. I asked her what 14 divided by 7 was and she couldn't tell me and she won't bring a calculator. So she tries to find out on that chart where's the 14 and where's the 7 and what did I multiply by and how did I get that. And she's trying to do her work and she's twice as long as the other students and there are several in [the class] at that level. She's going to be put in an algebra classroom with 28 to 30-some students or more? No one will ever get around to her!*

Teachers described how issues of class size affect their ability to work effectively in a heterogeneous classroom:

> *Class size is the biggest problem of all. When you're dealing with 35 kids who are not really equipped to take a course, you can't just give them the special help that you need to give them.*

> *Some of the classes are too large. Teachers can't possibly get around to answer all the questions in one period. That's one of the biggest difficulties I've noticed.*

> *My comment to an administrator is that you're either going to [give students] a 35-student-per-class education or you're going to get a 25-student-per-class education. They are different.*

> *They don't have enough teachers now. . . . I mean, we need three or four extra teachers in our building right now just to get the math class sizes down to say 22 to 25.*

Similar to this last comment, it was generally felt that the increase in class size was a direct result of a districtwide shortage of math teachers. In some buildings, teachers reported that math classes were being taught by teachers "who are not math teachers." One teacher said that her school had hired social studies teachers to teach math, to which another teacher responded, "So again, here's another time where kids lose out because they don't have a qualified teacher." In the new MPS strategic plan, increasing the percentage of math-certified teachers at the middle and high school levels has been identified as a targeted objective (Milwaukee Public Schools, 1998c).

The Limitations on Building Teacher Capacity

Despite the intensity and array of Equity 2000 professional development opportunities offered during the pilot phase, opportunities and funding support for teachers to participate in these activities were viewed as limited. Although the majority of MPS math teachers for grades 8-10 participated in Equity 2000 professional development (as reported in the previous section), the level and intensity of involvement was not the same for all teachers. Several people attributed this to the fact that teacher participation in summer institute training (which provided the most intensive training opportunity) is determined on the basis of seniority rather than teaching assignment — this in accordance with the union contract (Pelavin Research Institute, 1995). In addition, teachers and counselors who participated in staff development had to be paid at their full union wages, which averaged $130 more per day than the $60 stipend allocated for this activity by The College Board grant.[54] MPS had to make up the difference by using its own funds (Milwaukee Public Schools, 1991). One staff member from the Equity 2000 National Office estimated that this provision of the MPS teachers' contract "significantly curtailed" the number of teachers who could be involved in the summer institute or workshop activity at any given time.[55] Similarly, in a document entitled *Case Study Report on Milwaukee Public Schools*, Richmond (1996) reported that "many of the newer teachers do not get to attend the [Equity 2000] institutes and workshops . . . because of the cost factor, all teachers who might have an interest in participating in institutes are not able to do so" (p. 16).

Funds to support Equity 2000 professional development were further put to the test in 1994, when a site-based budgeting policy went into effect, resulting in "70 percent of all professional development funds [in the district being] determined at the individual school level" (according to one central administrator's estimate). This policy allowed each school to decide how to spend its professional development allocation and even whether to spend it on professional development at all. To solicit interest in and support for Equity 2000 professional development, the Equity 2000 coordinator would send information to school principals with the Equity 2000 training schedule and costs, often using The College Board grant as a leverage by which to offer registration incentives such as "buy one slot, get one free." A review of MPS annual Equity 2000 reports revealed that participation levels did not decline significantly with the advent of site-based budgeting for professional development.

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[54]The teachers' union sued the district to get the $130 per diem rate for Equity 2000 institute training in accordance with the union contract.

[55]This staff member indicated that lessons learned from the Milwaukee experience underscored the value of involving union representation in the planning stages of school improvement initiatives.

Even with access to professional development, MPS educators reported that issues such as the lack of access to needed resources, resistance to change, and low teacher expectations further served to hinder student achievement in algebra. Perhaps the most frequently cited inhibitor to change was limited access to, or lack of, school-level resources. In some cases this meant funds to pay for teachers' participation in training, but mostly it referred to schools' ability to provide classroom materials and adequate access to computers so that teachers could practice and apply newly acquired techniques. The following comments provide insights on this issue:

> *I was introduced to the graphing calculator at the first summer institute but I never used it [with students] until two years later because we didn't have classroom sets.*

> *We only have one computer lab and the English teachers were furious that we were monopolizing it three hours a day. But our principal said, "Tough!" So we got it.*

> *What we're talking about is a regular textbook is not the way to go anymore. However, if you don't give teachers the materials to work with, they are going to go to the textbook because it's the safest way to go.*

> *We feel comfortable with a book. . . . I'm not creative like you are [referring to another teacher], but if I had those activities already handed to me that would really improve, that would help me.*

There were also comments about teachers' resistance to change and the need to include a monitoring and/or accountability process as an incentive for teachers to use techniques introduced through Equity 2000 training:

> *It's human nature to teach the way you've been taught. . . . [To change practice,] you've got to persist longer than [teachers] resist.*

> *I have seen examples of teaching that did not appear to be engaging for students. . . . Teacher participation in professional development [is followed by] then going back in their class and doing the same old thing. This finding came out of earlier audits. Teachers need on-site help.*

> *Even in the well-intended spirit of Equity 2000, people operate in an entrenched mind-set. Teachers are still having some difficulty in shifting their paradigms. . . . The veteran teachers will attend in-service and come back and do the same thing.*

In regard to teacher expectations, perceived gains in this area were mixed. While some felt that the tide of low expectations for all students learning algebra had receded since the launch of Equity 2000, others thought a widely held belief that "algebra is not for everyone" persisted within the teaching ranks.

> *When [Equity 2000] first came and they said all students would be taking algebra, teachers were saying [all students] can't do algebra. Now, they say [all students] can do it but we have to know what to do to help them.*

When we first started the program we heard a lot of talk that all students cannot take algebra. I don't hear that anymore. The students proved them wrong.

Algebra-for-all was not a rallying cry for all teachers. I'd say that there has been a substantial number of teachers who've persisted in the sentiment that algebra is not for everyone. Their numbers vary from building to building from a small group to a rather large and entrenched group.

It's clear [that] many teachers had their expectations challenged; not all changed their views.

A trainer for Equity 2000 stressed the need for classroom-level follow-up to teacher institutes, which is now being provided through the Math/Science Resource Teachers (MSRTs):

As an MSRT, I worked in a school where teachers had participated in several trainings on manipulatives and the graphing calculator, but they were afraid to use it in front of their students because they weren't sure how to use it comfortably themselves. The school's supply closet was full of unused graphing calculators. So I provided in-service on using the calculators. After each training session, I stayed with teachers working with them in the classroom as a backup. Over a period of time they became more comfortable with using them.

This trainer solidified the point by adding: "Professional development itself is not the key. . . . The key is application and figuring out how to stimulate and support teacher application of new skills. Professional development that doesn't have accountability and follow-up in classroom support is not going to result in application."

V. Getting to the Right Algebra

Milwaukee Public Schools has come to learn well one of the first lessons espoused by Equity 2000: that the increased number of students taking algebra would also require changes in algebra curriculum and instruction. Indeed, one mathematics department chair notes that

> *the algebra-for-all mandate for ninth graders was a sort of a turning point for high school math; it changed the group of students we were dealing with in algebra. We had to figure out how we could make [algebra-for-all] work.*

Data collected during our preliminary review revealed that substantive change in mathematics curricula at the middle and high school levels is taking place. This movement is the result of MPS' overall push not only to raise academic standards through course-taking requirements (in mathematics and other discipline areas) but also to assess students' proficiency in these areas. Prompted by student achievement trends in Algebra I and supported largely through the resources of MUSI, MPS educators continue to forge new ground in hopes of better enabling *all* students to succeed in mathematics. This section of the paper describes recent efforts in the district to examine algebra curriculum content, sequencing, and instruction. More specifically, we focus on three interrelated areas: (1) what content algebra courses should include, (2) when students should learn algebra, and (3) how algebra should be taught.

Algebra Curriculum Content: What Is Algebra?

> *Curriculum is content — the topics, concepts, processes, and skills that students learn in mathematics classes. It includes the depth to which students explore content; the way teachers organize, sequence, and present it; and the textbooks and materials schools use.*
>
> — Shavelson, McDonnell, and Oakes (1989, p. 96)

Since 1990, MPS has operated on a "system of schools" governance philosophy that provides schools complete autonomy in their curriculum choices. In fact, until very recently, there was no algebra curriculum guide issued by the district. Consequently, wide variability exists among high schools in terms of Algebra I content and rigor. One district administrator and former mathematics teacher noted:

> *Because the district doesn't have a curriculum guide for algebra, some people have altered algebra content and symbol manipulations . . . a lot of calling classes algebra, but not really working on a mastery model.*

In a teacher focus group, the consistency (or more accurately, the *in*consistency) of the high school Algebra I curriculum was explained this way:

> *[E]very building is probably different, almost to the point of being different within each individual classroom and that creates a headache when we have children moving from building to building, or even from classroom to classroom. . . . I mean, systemwide, we're not all on the same page and it would be neat if that were the case, but then again, it's a very large system.*

Equity 2000 does not provide nor does it advocate specific algebra curriculum programs, although its professional development delivery model regularly includes discussions of NCTM standards and "Big Ideas" about algebra curriculum content.[56] Teachers, nonetheless, commented that Equity 2000 didn't go far enough to "fundamentally change the curriculum" and in some ways "was ahead of the curriculum":

> *That was one of the biggest problems with Equity 2000. They taught us a lot of instructional techniques, but no curriculum.*

> *We should spend more time on . . . factoring and polynomials. If students are going to really be successful in the advanced math courses, we need to cover it. I think one of the reasons we don't cover it is because The College Board says less is better, but by the same token if you don't cover it they're not prepared for their later courses.*

One of the coordinators for the MPS Equity 2000 audit process shared his insights in this regard: "The Equity 2000 philosophy pushed experiential learning, but teachers seemed to focus more on making sure that all the algebra elements were covered." A staff member from the Equity 2000 National Office also commented on the tension between the teaching and learning paradigm of Equity 2000 and the traditional objective of most classroom teachers: "Teachers focus on teaching math, and we're trying to get them to focus on teaching students. [Teachers] tend to fixate on covering the textbook." Barr and Tagg (1995) refer to these tensions as the instructional paradigm and the learning paradigm. The *instructional paradigm* focuses on content coverage and what the teacher does in the classroom, while the *learning paradigm* focuses on whether and how students learn. Equity 2000 espouses a learning paradigm approach, but enabling teachers to make the shift requires sustained energy, administrative support, time and other resources, and accountability systems that reflect an appreciation of authentic instruction (Lasley, 1998).

In some ways, the district has encouraged schools to follow the tenets of the NCTM standards. In 1992, the district adopted *Heath Algebra I: An Integrated Approach* as the high school Algebra I textbook. According to the MPS math curriculum specialist at that time, this textbook was selected because "it was one of only two books out of the ones we were looking at that halfway dealt with the [NCTM] standards." However, high schools have the option of using this textbook, and some teachers criticize the textbook as being "too advanced" and "overwhelming to students." One mathematics department chairperson felt that the textbook introduced abstract concepts too early for many students: "the textbook begins to talk about x and y on page 8, and by then you've already lost a lot of kids." Another teacher expressed concern that the application examples used in the book did not reflect most students' experiences in the real world:

> *The specific problems they use have little or no meaning to a lot of students that we deal with. They're talking about investing thousands of dollars in different ac-*

[56] A description of Equity 2000 professional development is presented in Section III.

counts. Our students, when you're talking about a school in inner-city Milwaukee, they're not able to deal with those types of problems.

Several factors in the district — key among them the MUSI, the algebra-for-all mandate, concerns about a watered-down Algebra I curriculum, teachers' frustrations with existing algebra curriculum resources, and the advent of math proficiency standards and assessments[57] — have prompted conversations around algebra content, and the question "What is algebra?" surfaced at the forefront of math curriculum reform in Milwaukee. An explicit process for determining what students should learn in Algebra I has been put into place. According to the *Annual Report of the Milwaukee Urban Systemic Initiative* (Milwaukee Public Schools, 1998a), a group of high school principals "requested a specific algebra curriculum including a scope and sequence" (p. 6). This charge led to the creation, in January 1998, of an Algebra Curriculum Committee, comprising math and science resource teachers, middle and high school math teachers, and university faculty.

Members of the committee report that they identified the goal of Algebra I as mastery of "linearity" and to "make sure kids really understand it, and we'll expose them to exponents and quadratics in the sense of comparing them to linearity." According to one committee member, initially the group attempted to "rewrite the [Heath textbook] curriculum, an impossible thing." The committee compromised by directing their efforts toward creating supplementary material for the Heath textbook, selecting at least "one rich problem" per chapter to show teachers a different pedagogical approach. In addition, the committee decided to replace the first two chapters of the Heath textbook with two units from MPS' newly adopted middle school math curriculum in order to smooth students' transition from arithmetic to algebra (details on the middle school math curriculum are described below). The MPS *Algebra I Guide: For Heath Algebra I* was completed in July 1998.

The new guide underscores the direction of change in algebra curriculum and instruction in Milwaukee by providing a framework for what an algebra class should look like, noting changes in

(1) the classroom setting:

[D]esks are not always facing the front. Students may be working together in small teams as is done in business and industry. . . .

(2) the teacher's role:

The teacher is no longer in front of the room. The teacher is a facilitator who . . . engages the students in conversations to assist them to clarify their ideas and concepts. . . .

(3) content:

The content is rich in inquiry, reflects high standards for all students, is delivered from a hands-on investigative approach. . . .

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[57]The new math proficiencies are explained later in this section.

(4) homework:

> *Homework is not just worksheets. . . . [It] is meant to reinforce classroom learning and/or to stimulate inquiry.*

(5) assessment:

> *Assessment is a varied and ongoing process [and] . . . can include research on projects, group presentations, portfolios, and engagement in class work. . . .*

Two in-service days were held in August to introduce high school algebra teachers to the first of the two replacement units for the Heath textbook. Additional in-services were held in the fall of 1998 to introduce the second replacement unit and to present instructional strategies that would assist teachers in developing lesson transitions to the Heath textbook. Also at that time, the High School Algebra Study Group was reestablished to provide an ongoing forum for teacher dialogue and networking about the algebra curriculum and instruction generally and about the application of the new curriculum guide in particular.

When Algebra Should Be Taught: High Standards in Mathematics Learning

Noting that the middle grades' curriculum was repetitive (in that students simply revisited the same concepts learned in elementary school), and thus failed to give students an adequate background for secondary school mathematics, the NCTM in its 1989 *Curriculum and Evaluation Standards for School Mathematics* advocated a revision of the traditional middle grades curriculum, suggesting that, among other things, algebraic concepts be included:

> *An ideal 5-8 mathematics curriculum would expand students' knowledge of numbers, computation, estimation, measurement, geometry, statistics, probability, patterns and functions, and the fundamental concepts of algebra.* (NCTM, 1989, p. 11)

When MPS adopted Equity 2000 in 1991, the eighth-grade mathematics curriculum was changed to "prepare all students with the mathematics foundation they will need to succeed in high school algebra and geometry" (Talborn, 1991, p. 14). The district adopted the ScottForesman textbook series *Exploring Mathematics* and *UCSMP Transition Mathematics* for the eighth-grade mathematics curriculum; the sixth- and seventh-grade mathematics curriculum remained unchanged. Sparked largely by MUSI and MPS' adoption of K-12 proficiency standards and new graduation requirements[58] — and, in part, by the aforementioned teacher concerns about the lack of student preparation in mathematics — Milwaukee is again in the process of changing the mathematics curriculum at the middle school level. This time, however, the curriculum for the entire middle school grade span is being revised to ensure that students are on track to meet the new high school graduation requirements. As presented in Table 5, by the end of eighth grade, students must demonstrate math proficiency in several areas, including algebraic concepts.

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[58]Beginning with the high school graduating class of 2004, students will be required to demonstrate proficiency in mathematics, science, communications, and community membership. Whereas current graduates are required to complete only two unspecified mathematics courses, the Class of 2004 and later graduates will be required to take three years of math beyond Algebra I.

Table 5

Grade 8 Mathematics Proficiencies[59]

Algebra	Five examples of "quality work showing an understanding of a range of algebra topics"
Mathematics Assessments	Proficient performance on one mathematics assessment.[60]
Scale Modeling	Student-developed project demonstrating; understanding of geometry, measurement, and proportional reasoning.

Source: Milwaukee Public Schools (1997c).

To gear up for this challenge, MPS middle school principals formed the Mobilization 2000 project. The MPS planning document for Mobilization 2000 indicates that Milwaukee teachers and administrators recognized that the middle school mathematics program needed to be revamped in order to prepare students for high school mathematics — particularly for algebra in the ninth grade. The document goes on to state that "student achievement in Milwaukee is lowest in the middle grades" and that on the 1996 Wisconsin State Assessment System (WSAS) "eighth-graders scored at the 30th national percentile in mathematics" (Milwaukee Public Schools, 1996b). Starting with the 1997-98 sixth-grade cohort, the district has identified what students should learn in grades 6 and 7 in order to meet the grade 8 mathematics proficiency requirements. These benchmarks, and other subject benchmarks, "are in place to help students and adults to direct their work in order to move students to the larger grade span targets" (Milwaukee Public Schools, 1996a).

While Milwaukee teachers believe that better middle school preparation is necessary for students to succeed in algebra, the following comments show that there is some question of how much algebra students will learn in the middle grades and whether the grade 8 mathematics proficiency examinations will be a sufficient demonstration that students have learned algebra:

> *They want seven samples of algebra work to fulfill the algebra requirement. That's not substantial enough to ensure that you know algebra.*
>
> *It's not going to be algebra [in eighth grade]. It will be called eighth grade math. [The students are] supposed to get algebra all through K-8. When you finish eighth grade, you'll have gotten all the algebra topics.*
>
> *The current seventh graders are now on line so that by the time they get to high school they will have had all the algebra they need. But they haven't provided the*

[59]The grade 8 proficiencies also include a research investigation project that students may complete using a variety of content disciplines.

[60]Students must demonstrate proficiency in mathematics based on the Wisconsin State Assessment System (WSAS) examination or the MPS middle school mathematics proficiency assessment.

seventh-grade teachers with the kind of method they need — or the sixth-grade teachers. They're working on it, but they institute these plans before they do the training that should have been completed.

Through Mobilization 2000 (and supported with MUSI resources), middle schools are responding to such concerns. Effective the 1998-99 school year, all MPS middle schools will implement the Connected Mathematics Project (CMP), a grade 6-8 curriculum which embeds algebraic concepts throughout.[61] The MUSI grant is being used to train middle school teachers how to implement this new curriculum. Equity 2000 summer institutes have also shifted their focus to provide CMP training for grade 6-8 middle school math teachers. High school math teachers are still concerned that, because middle school teachers are not certified in math, they may not have enough content knowledge to teach the math proficiencies. As one teacher put it, "I don't understand how they're going to move [algebra] down to eighth grade when they're not going to have [math-certified] teachers down there." Teachers are also worried about what will happen to students who fail the eighth-grade proficiency exams and whether the district is ready to handle some of the consequences of mandating that students meet the proficiency requirements in order to graduate from middle school to high school:

We don't know what will happen with kids who fail eight-grade math. You and I both know that some kids aren't mentally ready to have done algebra by the end of eighth grade; some kids aren't mentally ready until eleventh grade. Everything's up in the air. I hope somebody's thinking about what to do.

So if you're not going to pass algebra proficiency, you're not going to go into high school. I don't see anybody building a whole slew of new middle schools out there to hold these people who are not good at math proficiency!

We haven't thought that far ahead. . . . Assuming 90 percent pass, there's 10 percent that aren't going to make it, where are we going to hold the 10 percent to add to the 10 percent to add to the 10 percent? We're going to need alternative high schools, we're going to need special — whatever name you want to come up with to make it sound pretty — holding tanks for these people. If we don't have the middle school preparation and we don't have the back up and we don't have the money, and the class sizes are too big, and they swear you're going to have pass proficiency, where are these kids going to go?

How Algebra Should Be Taught: Changes in Algebra Curriculum and Instruction

Since the 1996-97 school year, three mathematics curriculum programs developed for secondary-level students (in addition to the Connected Mathematics Project at the middle school) have been adopted across MPS by various high schools. Three of these four curriculum programs were brought to the district through MUSI, and all were developed with funding support from the National Science Foundation. Teachers and administrators reported that Equity 2000 and the algebra-for-all mandate served to bring their attention to the need for comprehensive curriculum reform. As one teacher put it:

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[61]The Connected Mathematics Project curriculum is discussed in detail later in this section.

The failure rates are still very high. There's a real need to do something different; what we've been doing has not been successful. We need to talk about what [algebra] is and how it's approached.

The curriculum programs that have been adopted all emphasize new pedagogical approaches to teaching students algebraic concepts, and all are "stand-alone" rather than supplementary curricula; that is, they are designed to replace the traditional algebra courses rather than to supplement them.

Pittsburgh Urban Mathematics Project (PUMP). PUMP was introduced to the district in 1996 through a partnership between the then-MPS math curriculum specialist and IBM. Currently, 14 of the 18 MPS high schools are using this curriculum to varying degrees. PUMP developers state that the curriculum "is designed to help students learn to model real-life problem situations using algebraic representations including tables, graphs, equations, and words . . . the goal is to help all students be successful in algebra and see its relevance in both academics and the workplace" (PUMP, Web site). This curriculum heavily emphasizes the use of computers; on average, approximately 40 percent of the instructional time in PUMP classes is spent in the computer lab working with the PUMP Algebra Tutor (PAT). Students start by reading a contextual word problem, and the PAT then guides them through the process of finding a solution. The teacher circulates through the lab, offering hints and guidance. Because students work individually in the lab, they can move through the computer curriculum at their own pace. Therefore, it is possible — as observed in a summer school PUMP algebra class — that some students are working on exercises solving simple linear equations, while others are solving complex word problems and graphing systems of equations. During the 1997-98 school year, the district released a high school math teacher to serve part time as PUMP facilitator. The facilitator makes weekly visits to all schools that are using PUMP to provide coaching support and technical assistance to teachers. The facilitator also heads the PUMP teacher network, which meets monthly to share ideas about using PUMP.

While some debate exists as to whether or not there are gaps in PUMP's algebraic content, teachers agree that many students enjoy working with the computer at their own pace:

[Students] like the feedback of the machine. They'd get these little progress reports and they'd get a promotion and these kids that weren't very successful, they'd get these little promotions and they would just strut around the class and make sure everybody saw that they got promoted.

Teachers also like the fact that PUMP presents math problems that are contextual and meaningful to students:

All of the problems are done in words, situations are more real.

It's more accessible, I could talk about math concepts for the first time with my students.

It's a good integration of computer and class work.

However, teachers and administrators caution against overuse of the PUMP software component in that it may lead to too much repetition or may hinder students' application of math skills:

Some schools have become computer reliant in their efforts to support student achievement. I'm concerned that the process many of these software programs use is repetitive activities.

For some students it seems to do some good, some of the lower ones. But for some of the middle and some of the upper ones who have a good algebra background already. . . it doesn't do them a whole lot of good. They've seen it, it's very repetitive.

Some [teachers] had [students] sit at the computer all the time. I've had kids who couldn't do anything on graph paper, because they use [PUMP software] exclusively. And that's not good. It is supposed to be something that assists the kid rather than become the sole teaching device.

Connected Mathematics Project (CMP). CMP has been piloted in the district since 1996-97 and is being implemented in all MPS middle schools as of the 1998-99 school year.[62] CMP is designed for use in grades 6 through 8, and algebra is embedded throughout the curriculum, which also covers traditional middle school mathematics topics such as fractions, decimals, percents, and measurement. This curriculum consists of 24 "modules" or units, which explore the connections between five mathematical strands: number, geometry and measurement, probability, statistics, and algebra. CMP emphasizes that the teacher take on the role of facilitator, rather than lecturer. The developers of CMP believe that

> *it is not possible to separate the influence of what [mathematics] is taught from how it is taught. What students learn from the curriculum, i.e., the mathematical content of the curriculum, is shaped by how they learn to work with mathematics, i.e., the mathematics processes embedded in the curriculum. Conversely, how students learn to use mathematics shapes what they learn about mathematics and how concepts are understood and related.* (Connected Mathematics Project and Michigan State University, 1996)

Teachers we spoke with expressed excitement about the methodology which CMP uses to teach mathematics, but there was concern about the speed with which teachers will be expected to become comfortable with the program. Several expressed concern that teachers will need lots of training. A teacher who piloted the program noted:

If a teacher doesn't try to teach the modules the way that they were meant to be taught, it'll defeat the purpose of CMP. You need a lot of in-service with this type of book. [CMP training has] been done twice this summer. There should be other classes offered. I have a math background and I had to prepare a whole lot. I feel sorry for those who aren't math inclined. If they teach several subjects, it will be overwhelming.

High school math teachers also expressed concern that the CMP curriculum is not equivalent to a traditional first-year algebra curriculum. A member of the Algebra Curriculum Committee noted

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[62]CMP was chosen for districtwide adoption based on the results of a two-year comparison pilot test which included two other middle school math curricula — *Mathematics in Context* and *Integrated Mathematics Project*.

that "good teachers" only got through a few of the modules during the 1997-98 school year when the curriculum was still being piloted. Thus,

> *kids may get a lot of first-semester algebra, but maybe not even that. Symbol manipulation (a cornerstone of traditional algebra courses) is near the end of the eighth-grade modules — teachers may not get to it. Whether or not you can call it algebra depends on how far you get by the end of eighth grade. . . . Kids will have no chance at higher courses or college if you cheat them out of the foundations of algebra.*

Core-Plus Mathematics Project (CPMP) and Interactive Mathematics Program (IMP). Each comprising a four-year curriculum that integrates algebra, geometry, statistics, trigonometry, and discrete mathematics, CPMP and IMP are problem-based mathematics programs that replace the traditional Algebra I, Geometry, Algebra II/Trigonometry, Pre-Calculus sequence. Three MPS high schools have adopted CPMP: Washington High School piloted this curriculum in 1996-97, and Marshall and Bay View began to implement it in the 1998-99 school year. One school, Grand Avenue (an alternative combination middle school and high school serving grades 7-12) adopted IMP in 1996-97.

The primary goal of CPMP and IMP is to exemplify the reform suggested by the NCTM *Curriculum and Evaluation Standards for School Mathematics* (1989). Thus, these integrated math programs emphasize activities that are designed for groups of two to four students working together. Rather than being organized by topics, the curricula develop students' skills through problem solving. In focus groups, teachers who use CPMP or IMP talked favorably about these programs' different approach to mathematics teaching and learning:

> *I think it's great because they approach problems in a multitude of ways. Instead of looking at one way of doing it, they're looking at it as many different ways of solving the same problem.*

> *If you look at the book, you don't see 30 problems alike. You sit down and you work one problem and you work it to death from a dozen different directions. There's even problems that you come back two or three years later and you revisit the problem from a new perspective. And I like that because it really gives the kids a chance to really understand what is happening.*

While there are some benefits to integrating topics across the four years, there are also some disadvantages to using an integrated program, particularly in terms of assessment:

> *In the long run, [students] can do well, but in the short term, we may see some negative impact on test scores depending on when the tests were taken, because kids may not have reached the particular concept that the test is testing.*

> *If you have a city-wide algebra test for ninth grade, they don't do some of the ninth-grade concepts until the tenth or eleventh grade because it's integrated mathematics.*

Both CPMP and IMP emphasize collaborative group work and the use of cooperative learning techniques. However, some teachers say that students are reluctant to work in groups:

It's been a struggle to get kids to work in teams; it's been difficult.

Kids have to get over the obstacle of working together. There's an awful lot of student adjustment to the course.

Although the teachers who use CPMP and IMP are enthusiastic an integrated curriculum, they note that there are "some teachers who wouldn't touch it" and that it may be difficult to "impose" such a curriculum program on teachers.

As Table 6 illustrates, all the newly adopted mathematics curricula have several common tenets. Each emphasizes students' exploring mathematics as a real-world phenomenon and encourages the use of cooperative learning and collaborative group work. These curricula differ from traditional instructional approaches in their extensive use of student discussion and collaboration. Students' ability to communicate to an audience what they have learned is an integral component of classrooms in which these curricula are used. Technology is also an integral part of each program: PUMP uses interactive computer software extensively, and CMP, CPMP, and IMP encourage the use of graphing calculators and computer technology. Rather than the "topical learning" found in traditional mathematics courses — where students are instructed in one topic at a time (for example, "how to solve a linear equation") — the three integrated math programs (and PUMP, to a lesser extent) advocate student exploration of a single problem from a variety of approaches, using a variety of mathematical skills. The integrated math programs may use prompts from literature (for example, Edgar Allan Poe's "The Pit and the Pendulum") or real-world phenomena such as population growth to explore mathematical concepts such as periodic motion and nonlinear equations. PUMP emphasizes real-world projects (such as setting up a telephone network for a business) to explore patterns and hone mathematical skills.

Also common among these four curricula is that each reflects the essence of the NCTM curriculum standards, which "specify that instruction should be developed from problem situations [so that] students develop a framework of support that can be drawn upon in the future" (NCTM, 1989, p. 11). Further, the standards call for the use of calculators and computers in mathematics, because "technology is changing mathematics and its uses" (p. 8). Finally, the standards advocate that "although it is necessary to teach specific concepts and procedures, mathematics must be approached as a whole. The curriculum should include deliberate attempts, through specific instructional activities, to connect ideas and procedures both among different mathematical topics and with other content areas" (p. 11).

It should be noted, however, that the resources needed to support implementation of these curricular innovations over the long term raise another issue. PUMP requires thousands of dollars for computers and software, while IMP and CPMP require a similar amount for software and graphing calculators. For that matter, teachers and administrators thought that schools may be reluctant to purchase new materials for these new curricula considering that — if the district adopts a new high school math textbook, as is expected in a few years — these curriculum may not be in sync with the new textbook. The shift of algebra to the middle grades also leaves some teachers wondering about what the high school mathematics curriculum will look like in the year 2000:

[Incoming students] are going to take Core Plus, IMP, or something like that. We're going to do an integrated program. Everybody.

Table 6

Newly Adopted Secondary-Level Mathematics Curricula in Milwaukee (Since 1996)

Program	Description	Developers	Usage in MPS schools
Connected Mathematics Project (CMP)	• Grade 6-8 integrated curriculum • Emphasis on inquiry and exploration of problems • Algebra "embedded" throughout • Adopted by 2,200 schools nationwide	Connected Mathematics Project, Michigan State University (1991) Funder: National Science Foundation	• Piloted in three middle schools since 1996 • To be implemented in all 22 middle schools starting 1998-99 school year • Teacher supports: Equity 2000 1998 summer institute CMP training for middle school teachers; Linked Learning partnership with Marquette University; ongoing training in CMP curriculum
Pittsburgh Urban Mathematics Project (PUMP) Algebra	• Algebra curriculum • Computer-assisted instruction (40% of class time spent in computer lab) • Emphasis on developing algebraic skills that can be used in real-world situations	Pittsburgh Advanced Cognitive Tutor Center, Carnegie Mellon University (1993) Funders: National Science Foundation, U.S. Defense Advanced Research Project Agency (DARPA), and several Pittsburgh foundations	• Introduced to MPS in 1996 • Currently used in 14 high schools and one middle school • Usage: some schools — all 9th graders; some schools — advanced students; some schools — Algebra I repeater students • Teacher supports: three-day district in-service; PUMP network; district facilitator who provides technical and pedagogical assistance
Core-Plus Mathematics Project (CPMP)	• Grade 9-12 integrated curriculum (algebra, geometry, trig, etc.) • Emphasis on mathematical modeling and problem solving • Collaborative group work • Adopted by 103 schools nationwide	Core-Plus Mathematics Project (1992) Funder: National Science Foundation	• Piloted in one school since 1996 • Expanded to two additional schools in 1998-99 • Teacher supports: off-site training; peer consultation
Interactive Mathematics Program (IMP)	• Grade 9-12 integrated curriculum • Emphasis on mathematical modeling and problem solving • Extensive written and oral communication • Collaborative group work • Adopted by 243 schools nationwide	D. Resek and D. Fendel, San Francisco State University; S. Fraser and L. Alper, University of California at Berkeley (1989) Funder: National Science Foundation	• Piloted in one school since 1996 • Teacher supports: extra planning periods

Sources: Catalog of School Reform Models; MDRC interviews and focus groups with MPS educators.

The highest kids will go right into geometry, just like they always have. Stay on the calculus track if you will. But for the rest of them, for the majority of them, they'll go into Core Plus.

Some kids can't do the Geometry, Algebra II, Pre-Calculus sequence. Schools should experiment with some kind of integrated math program for kids who don't do the traditional sequence.

I don't know that we'll ever eliminate the traditional strand, because students may transfer who haven't done an [integrated math program]. While this [integrated mathematics approach] won't totally take over, it may become the dominant curriculum in our school.

Table 6 also shows that MPS schools are implementing these new curriculum programs in a variety of ways. However, yet to be determined from this most recent trend in mathematics curriculum reform is the impact on students' short- and long-term achievement. Some educators and mathematics advocates worry that such mathematics curriculum approaches may not provide adequate foundation for students to master algebra and geometry and more advanced mathematics concepts. There is also concern that the integrated math programs may not align with accountability assessments. Certainly, the array of approaches being used in Milwaukee provides fertile ground for putting these issues to the test. Such a study would be particularly timely, given that The College Board has developed an end-of-year Algebra I assessment that could serve as the standard tool for assessing student mastery in algebra. This assessment could be administered to students who are taught algebra using new curriculum programs as well as to those who enroll in the traditional one-year Algebra I course. All the original Equity 2000 districts piloted this assessment in spring 1998. In Milwaukee, the assessment was administered to all students in eighth and ninth grades. MDRC was unable to obtain the results of the assessment, but clearly this tool could be used to answer a lot of questions that math educators, policymakers, and community advocates have about whether students who are taught algebra through these various curriculum options can demonstrate proficiency in the subject.

VI. The Legacy of Equity 2000 in Milwaukee

Once referred to as the "centerpiece of reform" in MPS, Equity 2000 is now one of several prominent reform initiatives which, during the 1990s, moved the district in a common direction toward high standards. (An overview of MPS' context of reform is presented in Appendix A.) Administrators and teachers alike report that this synergy of initiatives has contributed to creating broad-based support and the staying power that is needed for long-term improvement. In trying to understand the specific legacy of this one initiative, we found that seven years after its introduction to MPS, Equity 2000 sustains an indelible presence within the district's overall school improvement priorities.

Information collected by MDRC during the 1997-98 school year indicates that costs related to ongoing implementation of Equity 2000 components are funded locally or through other leveraged resources. The MUSI director reported in November 1997:

> *We have institutionalized Equity 2000. Funding from The College Board has decreased while funding from the district for Equity 2000 has increased. Since 1996-97, the district has assumed costs for the full-time Equity 2000 Coordinator's salary. Professional development activities are paid for through district Eisenhower funds, individual school professional development budgets, and a DeWitt Wallace grant. The district has also allocated $200,000 district-wide to support school math tutoring activities. We have a $65,000 grant from the Aetna Foundation for Saturday Academies.*[63]

Equity 2000 institutionalization extends beyond professional development and safety net support structures. The initiative's emphasis on disaggregating student achievement data has served to strengthen this activity throughout the district. As one administrator stated, "Equity [2000] has taught us the value of disaggregating data. We would disaggregate before, but now we do a much better job of examining subgroup trends." Another administrator said, "Equity 2000 data collection techniques are making us aware of our goals and progress in reaching them." Because of Equity 2000, Algebra I passing rates are included as a performance measure for annual school accountability reports compiled by the MPS Office of Research and Assessment. These reports provide trend data on Algebra I and English 9 passing rates[64] and other performance outcomes (such as attendance, grade-point averages, state assessment passing rates, and — for high schools only — percentage passing high school proficiency exams). Disaggregated trend data on student participation in advanced-placement courses, college entrance examinations, and college enrollment have been compiled annually since 1992. Similarly, MPS partnerships with local institutions of higher education have been strengthened through such initiatives as Equity 2000 and MUSI. In particular, the University of Wisconsin-Milwaukee and Marquette University are central partners in the MPS reform efforts in that they provide a wealth of resources, expertise, and professional growth opportunities focused on mathematics teaching and learning.

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[63]The Aetna grant expired in June 1997, but MPS officials anticipate that a Goals 2000 grant will be used to continue the Saturday Academy.

[64]For middle schools, these data are reported for the most recent graduating eighth-grade class.

The ongoing influence of Equity 2000 as expressed by MPS educators reflects a perception that this initiative has played a pivotal role in actualizing high standards:

> *Equity [2000] gave us substance; it put meat on the bones of the K-12 Learning Initiative.*
>
> *Equity [2000] has certainly been the impetus for us. We didn't know if we could get students to rise to the occasion until Equity. We can no longer use the excuses that stopped us from really trying in the past.*
>
> *Equity 2000 proved that we could get students learning at higher levels. Now, what we did for math with Equity 2000, we want to do in other disciplines through MUSI and the proficiency standards.*
>
> *Equity 2000 gave us the confidence to know that we could challenge students to achieve at high levels. That led us [to] believe that we could promote high standards in the other disciplines and to start working with students in earlier grades. . . . Equity 2000 has been institutionalized within our standards.*

If the full promise of enrollment in higher-level courses is to be achieved in MPS and other school systems, it is necessary to improve the quality of content and instruction in ways that enhance achievement for all students. MPS continues to work toward this goal by adopting alternative curricula approaches in hopes of enabling all students to achieve at high standards in mathematics. In this paper, we attempted to identify some issues that are worthy of further study in moving this agenda forward:

- Strategies to monitor and best serve the needs of Algebra I "repeater" students emerged as a major issue. It may be worthy of study to identify and review the types of reassignment or instructional strategies that are used with this population to determine how best to raise math achievement among repeaters.

- Lessons from the Milwaukee experience show the value as well as the challenges of implementing a comprehensive professional development effort that links intensive training workshops with ongoing follow-up and classroom-based support. Teacher-to-teacher networks and coaching, access to resources, and monitoring and accountability were suggested as key supports in transferring workshop information into classroom application.

- The safety net support structures that MPS has created to enhance students' mathematics achievement have the potential to serve a substantial amount of students. The district's investment in such activities warrants a closer look: For which students, and in what ways, are these safety nets successful in increasing achievement in mathematics?

- To better accommodate the diverse learning needs of students, teachers and administrators advocate the need to provide different Algebra I curriculum options. Sentiment in MPS around the possibility of offering algebra curricu-

lum options may yield opportunities for future research on alternative approaches to ability grouping.

- Certainly, Milwaukee provides fertile ground for a study of the effects of the new approaches to mathematics curriculum and instruction. Such a study would be particularly timely, given that The College Board has developed an end-of-year Algebra I assessment which could serve as the standard tool for evaluating the rigor of all approaches to algebra instruction, including the traditional one-year Algebra I course.

Appendix A

Context of Reform in Milwaukee Public Schools

District Context and Reforms

MPS is considered a leading district in high-standards reform. In 1995, *Business Week* described MPS as "among the most aggressive systems overhauling American urban education." At the heart of MPS' reforms during most of the past decade has been the **System of Schools** policy (adopted in 1990), which embraces the notion that school improvement happens best when decision making and accountability are placed at the school level. Over the years, MPS has instituted a series of overarching education reforms that provide targets for site-level school improvement activities. Table 7 presents a chronological listing of MPS' education reform efforts over the past eight years.

MPS began the journey toward high standards in 1990 with the **K-12 Teaching and Learning Initiative**, a set of core beliefs for student learning and the educational environment that was centered on (1) articulation of specific goals for student performance, (2) high expectations for all students, (3) the elimination of academic tracking, (4) understanding of and attention to different learning styles, and (5) the professionalization of teachers. The following year, MPS adopted **Equity 2000,** which offered specific action steps to reach high standards in mathematics through Algebra I enrollment for all students at ninth grade; staff development for teachers, guidance counselors, and principals; academic support activities for students; and decision making using disaggregated data. In 1991, the district also launched its first in a series of **assessment reform** strategies, which over the following three years, resulted in replacing multiple-choice district exams with performance-based assessments. The **MPS Accountability Plan** in 1993 provided a reporting system for documenting progress in each school against its own as well as district performance benchmarks from year to year. The accountability plan further solidified the district's focus on data disaggregation as a tool for addressing equity issues and achievement gaps among student populations. MPS launched one of the first districtwide **School-to-Work** initiatives in 1994, seeking to change the nature of teaching and learning so that

MPS Demographics at a Glance

Number of schools: 163
Number of teachers: 6,507
Number of students: 106,261
Black: 61%
White: 20%
Hispanic: 12%
Asian: 5%
Other: 2%
Free lunch eligible: 75%

High school attendance rate: 74.9%
Annual dropout rate: 12.1%

NCE scores in mathematics on the Wisconsin State Assessment System (WSAS):
Grade 4: 33
Grade 8: 31
Grade 10: 38

Percentage of high school seniors who passed the MPS Math Proficiency Test:
1995-96: 91.4%
1996-97: 90.9%

Source: Milwaukee Public Schools, 1997b.

Table 7
Education Reform in Milwaukee Public Schools (1990-1998)

1990

System of Schools: Site-based decision making and budgeting; "schools must be given the opportunity to find the best methods and alternatives to implement reform for their students."

K-12 Teaching and Learning Initiative: Curriculum standards, high expectations for all learners, and ongoing professional development.

1991

Equity 2000: Algebra I (or higher) for all ninth graders; ongoing professional development for teachers, counselors, and principals; Saturday Academy for middle and high school students; Parent Academy; partnerships with institutions of higher education; and expanded use of disaggregated student data.

Assessment Reform: Introduced the implementation of writing sample assessments at the elementary level. Over the following three years, district-sponsored multiple-choice assessments were eliminated, and performance assessments were put in place in science, mathematics, writing, speaking, and the arts.

1993

MPS Accountability Plan: Annual progress measure of school performance based on indicators of student achievement including tests scores, writing samples, grades, attendance, proportion enrolled in AP courses, and truancy/dropout rates; expanded to include equity measures (including gap statistics and trends) in 1995-96.

1994

School to Work: Federally funded initiative that promotes students' understanding of the relevance of classroom learning to the world of work; includes employer-school partnerships.

Graduation Proficiency Examinations: Proficiency exams in writing and mathematics replace high school minimum competency tests.

1995

Proficiency Standards and Class of 2004 Graduation Requirements: K-12 proficiency standards and new graduation requirements in science, mathematics, and communications (reading, writing, and oral communication); end-of-grade 8 proficiencies in mathematics (first-year algebra), science, and communication to be mandated in the year 2000.

1996

Milwaukee Urban Systemic Initiative (MUSI): NSF-funded initiative that focuses on achievement in mathematics and science by targeting K-12 curriculum reform and teacher professional development, including the development of curriculum frameworks, refinement of the districts' proficiency assessments, and the unified adoption of curriculum programs for mathematics and science.

1998

Strategic Plan: Focus on literacy, math and science curricular reform; teacher certification and training in math and science; curriculum alignment with state and national assessments; and summer school for elementary, middle, and high school students performing below grade level.

students would better understand the connection between what goes on in the classroom and the world of work. School-to-Work and Equity 2000 were complementary in their focus on linking the relevancy of academic subjects to real-world experiences and the importance of career awareness and exposure. In 1995, MPS adopted rigorous new **K-12 proficiency standards** and new **high school graduation requirements** (including three years of math beyond Algebra I) starting with the Class of 2004. The proficiency standards raise the bar for high expectations, particularly in the area of mathematics, where the proficiencies require mastery of algebraic concepts by the end of eighth grade. In 1996, MPS received a five-year grant from the National Science Foundation (NSF) to implement the **Milwaukee Urban Systemic Initiative** (MUSI), which focuses on comprehensive curricular reform in mathematics and science. The goals of MUSI and Equity 2000 are inextricable. As one MPS administrator stated, "If it weren't for Equity [2000] there wouldn't be a MUSI." MUSI serves in many ways to extend the principles of Equity 2000 throughout the K-12 curriculum.

Most recently, in 1998 MPS Superintendent Dr. Alan Brown spearheaded the design of a five-year **Strategic Plan (1998-2003)**, which emphasizes five key goals: (1) literacy enhancement through a menu of school-based literacy programs and a central reading curriculum, (2) math and science enhancement through MUSI, (3) support to increase the number of certified teachers in mathematics and science, (4) professional development to enhance curriculum alignment with state tests, and (5) summer school to enhance performance of students performing below grade level.

Appendix B

Other Professional Development Math Initiatives in Milwaukee Public Schools

Elementary School Initiatives

Cognitively Guided Instruction (CGI) is a mathematics program for primary grades which emphasizes problem solving. By the end of grade 1, children in CGI classrooms are solving problems that algebra students encounter in grade 9 (linear equations in one variable). Six elementary schools have participated in a one-year training effort, and staff are working to extend the project to other schools by utilizing teachers as trainers.

Middle School Initiatives

Assessment Communities of Teachers (ACT) was a federally funded project that involved all middle school mathematics teachers in assessment reform. This three-year project began in 1994-95 and developed teams of teachers at each middle school who helped guide the development and use of effective measures of achievement.

Mathematics, It's Not a Problem is financed by a Ford Foundation grant. The Greater Milwaukee Education Trust is collaborating with MPS on the second year of a program targeting students in grades 6-8 and their parents about the importance of mathematics. This program includes the production and distribution of corporate videos for use in mathematics classrooms, problems of the week published in the *Milwaukee Sentinel*, and SIM City competitions.

Middle and High School Initiatives

Leadership in Urban Mathematics Reform (LUMR) is a three-year project that has been funded by NSF through the Urban Mathematics Collaborative (Marquette University, locally). It will involve two teachers from each of fourteen schools (middle and high). The focus of the project is success in algebra. Teachers will engage in action research and will support each other through meetings and a national computer network which links Milwaukee to the five other cities participating.

Source: Jasna, 1995.

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Education Reform

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A study of innovative programs that help students make the transition from school to work or college.

The School-to-Work Transition and Youth Apprenticeship: Lessons from the U.S. Experience. 1993. Thomas Bailey, Donna Merritt.

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Project Transition

A demonstration program that tested a combination of school-based strategies to facilitate students' transition from middle school to high school.

Project Transition: Testing an Intervention to Help High School Freshmen Succeed. 1999. Janet Quint, Cynthia Miller, Jennifer Pastor, Rachel Cytron.

Other Programs for Youth

The JOBSTART Demonstration

A test of a program combining education, training, support services, and job placement for very disadvantaged young high school dropouts.

JOBSTART: Final Report on a Program for School Dropouts. 1993. George Cave, Hans Bos, Fred Doolittle, Cyril Toussaint.

The Career Beginnings Evaluation

An evaluation of a program that seeks to increase college attendance and improve job quality among disadvantaged high school students.

Career Beginnings Impact Evaluation: Findings from a Program for Disadvantaged High School Students. 1990. George Cave, Janet Quint.

The Youth Incentive Entitlement Pilot Projects (YIEPP) Demonstration

A test of a school-conditioned job guarantee for low-income youth.

Lessons from a Job Guarantee: The Youth Incentive Entitlement Pilot Projects. Monograph. 1984. Judith Gueron.

Note: For works not published by MDRC, the publisher's name is shown in parentheses.

Programs for Teenage Parents on Welfare

The LEAP Evaluation

An evaluation of Ohio's Learning, Earning, and Parenting (LEAP) Program, which uses financial incentives to encourage teenage parents on welfare to stay in or return to school.

LEAP: Final Report on Ohio's Welfare Initiative to Improve School Attendance Among Teenage Parents. 1997. Johannes Bos,Veronica Fellerath.

The New Chance Demonstration

A test of a comprehensive program of services that seeks to improve the economic status and general well-being of a group of highly disadvantaged young women and their children.

Lives of Promise, Lives of Pain: Young Mothers After New Chance. Monograph. 1994. Janet Quint, Judith Musick, with Joyce Ladner.

New Chance: Final Report on a Comprehensive Program for Young Mothers in Poverty and Their Children. 1997. Janet Quint, Johannes Bos, Denise Polit.

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Project Redirection

A test of a comprehensive program of services for pregnant and parenting teenagers.

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The Community Service Projects

A test of a New York State teenage pregnancy prevention and services initiative.

The Community Service Projects: Final Report on a New York State Adolescent Pregnancy Prevention and Services Program. 1988. Cynthia Guy, Lawrence Bailis, David Palasits, Kay Sherwood.

About MDRC

The Manpower Demonstration Research Corporation (MDRC) is a nonprofit, nonpartisan social policy research organization. We are dedicated to learning what works to improve the well-being of low-income people. Through our research and the active communication of our findings, we seek to enhance the effectiveness of social policies and programs. MDRC was founded in 1974 and is located in New York City and San Francisco.

MDRC's current projects focus on welfare and economic security, education, and employment and community initiatives. Complementing our evaluations of a wide range of welfare reforms are new studies of supports for the working poor and emerging analyses of how programs affect children's development and their families' well-being. In the field of education, we are testing reforms aimed at improving the performance of public schools, especially in urban areas. Finally, our community projects are using innovative approaches to increase employment in low-income neighborhoods.

Our projects are a mix of demonstrations – field tests of promising program models – and evaluations of government and community initiatives, and we employ a wide range of methods such as large-scale studies to determine a program's effects, surveys, case studies, and ethnographies of individuals and families. We share the findings and lessons from our work – including best practices for program operators – with a broad audience within the policy and practitioner community, as well as the general public and the media.

Over the past quarter century, MDRC has worked in almost every state, all of the nation's largest cities, and Canada. We conduct our projects in partnership with state and local governments, the federal government, public school systems, community organizations, and numerous private philanthropies.